

JPRS 69328

28 June 1977

U S S R

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
MATERIALS SCIENCE AND METALLURGY  
No. 46

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28 June 1977

# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## MATERIALS SCIENCE AND METALLURGY

No. 46

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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USSR

UDC 669.71'25+669.71.1

THE KINETICS OF DISSOLUTION OF COBALT AND IRON IN LIQUID ALUMINUM

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 91-94 manuscript received 4 Feb 76

YEREMENKO, V. N., NATANZON, YA. B., TITOV, V. P.

[Abstract] The kinetics of dissolution of cobalt and iron in liquid aluminum were studied in the 700-900°C temperature interval with rotation rates of the disk specimen of 6.61-36.80 sec<sup>-1</sup> on a special vacuum installation. The materials used included aluminum of 99.995% purity, electrolytic cobalt of 99.98% purity and carbonyl iron of 99.99% purity. The primary non-metallic inclusions in the iron were nitrogen at 4·10<sup>-3</sup>, carbon at 5·10<sup>-3</sup> wt.% and oxygen. The iron powder was roasted in a current of purified hydrogen at 850±20°C for four hours in order to reduce the carbon content below the threshold of sensitivity of standard methods of analysis (~5·10<sup>-5</sup>%). It was determined that the dissolution of cobalt and iron in liquid aluminum occurs in the diffusion mode. In the 700-900°C temperature interval the solubility, rate constants of solubility and diffusion factors of cobalt and iron in liquid aluminum were determined and are presented in graphic form. Figures 5; References 9: 7 Russian, 2 Western.

USSR

UDC 669.71-154:532.13

THE VISCOSITY OF LIQUID ALUMINUM

Moscow IZVESTIYA AKADEMII NAUK SSR, METALLY in Russian No 2, Mar-Apr 77  
pp 65-70 manuscript received 9 Mar 76

ARSENT'YEV, P. P., POLYAKOV, K. I.

[Abstract] A study was made of the viscosity of liquid aluminum of varying degrees of purity both as to concentration of metallic impurities and as to content of oxide inclusions. The viscosity of the melts was measured on a viscosimeter based on the method of torsional oscillations of a cylindrical crucible filled with metal. The measurements were performed in alumina crucibles. The 40 g specimens were tested in a neutral atmosphere consisting of high purity helium. Viscosity was determined during heating and cooling in the 670-1000°C temperature interval, with particular attention being given to the 670-770°C interval. It was found that the viscosity of liquid aluminum varies greatly with the content of impurities, increasing with an increasing concentration of impurities. Based on the measurements of viscosities, no significant structural changes in the liquid aluminum

were found in the temperature interval studied. Measurement of the viscosity of metals which are active (with respect to oxygen) requires that the possibility of formation of oxide films be considered, since this reflects on the accuracy of the results produced. Figures 4; References 17: 16 Russian, 1 Western.

USSR

UDC 621.986:621.892

RESIDUAL SECOND-ORDER STRESSES IN ALUMINUM DEFORMED BY ULTRASOUND

Minsk DOKLADY AKADEMII NAUK BSSR in Russian No 11, Nov 76 pp 995-998  
manuscript received 13 Feb 75

SEVERDENKO, V. P., Academician Academy of Sciences BSSR, PUTAN, L. A., and PETRENKO, S. I., Physicotechnical Institute of the Academy of Sciences BSSR, Belorussian Polytechnical Institute

[Abstract] In an investigation of the action of ultrasound upon deformed aluminum, it is established that the level of residual second-order stresses, in the contact surface layer of aluminum specimens clenched at the antinode of the displacements and the antinode of the stresses of an ultrasonic wave, is lower by 25 and 32%, respectively, than in the surface layer of specimens deformed without ultrasound. Figures 2; References 6: 4 Russian, 2 Western.

## Analysis and Testing

USSR

UDC:620.179.14:669.14.018.26

### NONDESTRUCTIVE TESTING OF THE MECHANICAL PROPERTIES OF STEELS FOR DEEP STAMPING

Moscow STAL' in Russian No 2, Feb 77 pp 167-170

MEL'GUY, M. A., SHIDLOVSKAYA, E. A., VOSTRIKOV, A. A., PYATUNIN, G. A. and PIUNOV, V. D., Department of Physics of Nondestructive Testing, Academy of Sciences BSSR, Magnitogorsk Metallurgical Combine and Cherepovetsk Metallurgical Plant

[Abstract] The results of studies of O8kp and O8Yu steels, laboratory and commercial tests performed with the cooperation of the Central Scientific Research Institute for Ferrous Metals demonstrate the possibility of replacing direct testing of the mechanical properties by a nondestructive method using the IMA-2A instrument. All steels covered by All-Union State Standard GOST 9045-70 differ in their chemical composition only in the addition of deoxidizers to eliminate aging. This has no significant influence on the linearity of the correlation between magnetic and mechanical properties, and the results produced can be extended to type O8ps and O8Fkp steels as well. The linear correlation is valid within a thickness range of 0.5-3 mm for these steels. The most suitable magnetic parameter for nondestructive testing of mechanical properties is the coercive force. The IMA-2A magnetic pulse analyzer recommended was developed at the Department of Physics of Nondestructive Testing, Academy of Sciences BSSR. Regression equations (linear and corrected for nonlinearity) are produced. Figures 5; References:14 Russian.

## Coatings

USSR

UDC 669.295'786.867

### ESTIMATING THERMAL STRESSES IN VERY HARD COATINGS

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 182-187 manuscript received 18 Jun 75

BAKHMINTSEV, G. B., YERMOLOV, V. A.

[Abstract] A mathematical model is developed to determine the thermal stresses in a coating near its edge. This is done by cutting from the coating a strip and applying normal and tangential stresses. The problem is reduced to calculating the stresses in a beam lying on a continuous elastic base and loaded by a moment. Analysis of the modeling equation produced shows that the precipitation of coatings at high temperatures results in the formation of significant thermal stresses which reduce the strength of bonding of the coating to the substrate. The equation obtained models the distribution of separating forces between coating and substrate as a function of the physical and mechanical properties of the coating and rigid substrate. Thermal stresses in very hard coatings of titanium nitride atomized onto rigid and ductile substrates are calculated. Figures 5; References: 3 Russian.

USSR

UDC 621.785.539:661.65:620.18

### ON THE STRUCTURE OF DIFFUSION BORIDE COATINGS ON STEELS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1977 pp 66-67

ALIMOV, YU. A., Zhdanov Branch of the Research Design Technology Institute "Pochvomash"

[Abstract] Employing the method of fractographic analysis the author established that acicular boride crystals in coatings on KhVG steel have a bifurcated structure which guarantees stronger adhesion to the base metal. The author found furthermore that the fractographic method permitted him to measure the depth of the borated layers with greater precision than allowed by metallographic analysis. As a consequence the author was able to reduce the borating time and produce a significant economic effect. Figures 2; References: 3 Russian.

USSR

INFLUENCE OF TREATING THE SURFACE OF STEEL WITH A GLOW DISCHARGE ON THE ADHESION AND POROSITY OF VACUUM COATINGS OF FTOROPLAST-3

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 1(73) 1977 pp 43-45

ZADOROZHNYI, V. G., RAFALOVICH, D. M. and ROYKH, I. L., Odessa

[Abstract] The authors investigate the influence of treating steel with a glow discharge on the adhesion and porosity of vacuum coatings of Ftoroplast-3 [polychlorotrifluoroethylene (Kel-F)]. They established that treatment with a glow discharge and heating in a vacuum up to 60°C improve the adhesion of the coatings to the backing and decrease porosity. The best regime of treating the surface of steel before deposition of the coatings is heating to 600°C with subsequent cooling and treatment with a glow discharge with a current density of 1 mA/cm<sup>2</sup> for a period of 60 seconds. Accelerated corrosion tests in an atmosphere containing 0.1% SO<sub>2</sub> and in a salt fog chamber showed that coatings of Ftoroplast-3, 10 micrometers in thickness, reliably protect the steel from corrosion. Figures 2; References 9: 6 Russian, 3 Western.

USSR

DEPOSITION OF COMPOSITE COATINGS BY THE ELECTROARC METHOD

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 1(73) 1977 p 26

SAYFULLIN, R. S., ABDULLIN, I. A. and GINIYATULLIN, N. G., Kazan'

[Abstract] The authors suggest the deposition of composite coatings using the EM-10-66 industrial electrometallizer. A batcher of refractory particles is fed to the nozzle channel of this metallizer with a skew toward the line of the nozzle axis of 25-30°, which permits creating a vacuum of 0.2-0.3 atm in the batcher. The optimal conditions for depositing the composite coatings on a base of steel wire upon drawing at a rate of 80 cm/min and air flow rate of 2 m<sup>3</sup>/min in a working current of 280-300 A permit obtaining composite coatings with a content of the refractory phase of 10-15 mass %. Figures 1; References: 5 Russian.

USSR

ADHESION OF AN ELECTROCHEMICAL NICKEL COATING TO THE SURFACE OF CARBO-  
GRAPHITE MATERIALS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 1(73) 1977  
pp 23-25

PONOMAR', V. V., Kishinev

[Abstract] The author demonstrates that the adhesion of an electrochemical nickel coating to carbon glass is insignificant and is determined by mechanical adhesion of the nickel film with the surface of the carbon glass. Preliminary anode treatment in the working solution and anode treatment in a 60% solution of nitric acid improve the adhesion of nickel to carbon glass. The results of the investigations obtained by the electrochemical method correlate with the quantitative data on measuring the cohesiveness obtained by direct separation of the coating from the backing. Figures 1; References 10: 7 Russian, 3 Western.

USSR

UDC 621.793.3

PRODUCING COMPOSITE COATINGS OF  $\text{Cu-Al}_2\text{O}_3$  BY THE METHOD OF CHEMICAL  
DEPOSITION

Moscow IAN SSR, NEORGANICHESKIYE MATERIALY in Russian Vol 13, No 3, Mar 77  
pp 496-498 manuscript received 13 Oct 75

GUSEVA, I. V., MASHCHENKO, T. S. and BORISENKO, A. I., Institute of  
Silicate Chemistry imeni I. V. Grebenshchikov, Academy of Sciences USSR

[Abstract] The authors investigate ways to improve the properties of metal coatings by including disperse inorganic fillers in their composition. They demonstrate the possibility of producing composite coatings of  $\text{Cu-Al}_2\text{O}_3$  by the method of chemical reduction and investigate the process of depositing such coatings onto pyroceramic plates. They show that the introduction of  $\text{Al}_2\text{O}_3$  into copper coatings more than doubles their microhardness and results in an increase in the specific electrical resistance. Figures 4; References: 1 Western.

USSR

UDC 669.15'71

DECOMPOSITION OF THE METASTABLE  $\gamma$  PHASE IN Fe-Al POWDER COMPOSITES PRODUCED AT HIGH COOLING RATES

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 169-171 manuscript received 7 Oct 75

GAL', A. I., GAL', V. V., FANIN, R.

[Abstract] This work studies the decomposition of the metastable  $\gamma$  phase in Fe-Al powder composites produced by condensation from the gas phase at rates of  $10^2$ - $10^5$  C·sec<sup>-1</sup>. The qualitative phase composition of the composites was determined by x-ray studies at room temperature using monochromatic  $K\alpha$  iron radiation. The quantitative phase composition was determined in unfiltered iron radiation by the method of homologous pairs. The  $\gamma \rightarrow \alpha$  transformation in composites was studied by heating the specimens in a vacuum of  $5 \cdot 10^{-5}$  mm Hg to 500°C. The rate of heating and cooling upon annealing was 20 C·min<sup>-1</sup>. The phase composition of Fe-Al powder composites produced by condensation from the gas phase depends on the cooling rate: at cooling rates of  $10^4$ - $10^5$  C·sec<sup>-1</sup>, the two-phase composition is present ( $\alpha + \gamma$  iron) while at  $10^2$  C·s, a single phase composition ( $\alpha$  iron) is present. The decomposition of the  $\gamma$  phase in a composite with 2.2 wt.% Al is characterized by an activation energy of  $8.8 \pm 0.4$  kcal·mol<sup>-1</sup>. Figures 3; References: 6 Russian.

USSR

UDC 621.762:669.018.29(088.8)

A COMPOSITE SINTERED MATERIAL

USSR AUTHOR'S CERTIFICATE No. 515819, FILED 1/03/73, NO 1896484,  
PUBLISHED 27/07/76 in Russian

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 3G497P  
by T. Kozlovskaya]

OL'SHEVSKIY, A. A., MIROTVORSKIY, V. S.

[Text] A composite sintered material is suggested, containing a matrix based on Cr, alloyed with Fe and W fiber. In order to increase strength, the matrix also contains Mo and Y with the following relationship of components of the material (in %): W fiber 30.0-90.0, Fe 1.0-35.0, Mo 0.5-7.0, Y 0.01-1.3, Cr -- remainder. Composite sintered materials were manufactured by cold pressing of a mixture of powders of the initial component of the matrix with continuous W fibers of alloy VT-7 0.5 mm in diameter with a



specific pressure of 8-12 t/cm<sup>2</sup> with subsequent sintering at 1350-1400°C for 1-1.5 hr in a vacuum of 1·10<sup>-2</sup>-1·10<sup>-3</sup> mm Hg. The material suggested can be used in turbine construction, aircraft and rocket building, nuclear technology and other areas of technology.

USSR

UDC 621.762

#### INVESTIGATION OF THE INTERACTION OF CARBON FIBERS WITH MAGNESIUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3(171) Mar 77, pp 50-54  
manuscript received 22 Apr 76

DEMENT'YEV, S. I., ZABOLOTSKIY, A. A., ROMANOVICH, I. V., PROKOF'YEV, S. A. and SALIBEKOV, S. YE., All-Union Scientific Research Institute of Aviation Materials

[Abstract] The authors investigated the interaction of carbon fibers with a magnesium matrix during the formation of a composite material and during heat treatment simulating the conditions of its exploitation. They demonstrated that preparing samples of the composite material by the method of saturating the contact with the matrix melt (temperature of 660-780°C, holding time 5 min) does not lead to softening of the fiber filler. After heat treatment at temperatures up to 450°C at 100-500 hours there is also no change in the strength characteristics of the carbon fibers noted. In the temperature range of 450-660°C (range of magnesium carbide stability) and holding times up to 100 hours, a substantial softening of the fibers is observed accompanied by the formation of precipitations of the carbide phase. They investigated the structures of the carbon fibers and show that their softening during interaction with the matrix is associated with the buildup of surface defects. Figures 2; References 9: 2 Russian, 7 Western.

USSR

UDC 669.24'26'28'782-426

MANUFACTURE OF THIN METAL FIBERS OF BRITTLE, HIGH-STRENGTH MATERIALS

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 239-245 manuscript received 23 Dec 75

SHUVALOV, YE. V., FARMAKOVSKIY, B. V., LAVRUT, T. A., KARASIK, N. YA.,  
Leningrad

[Abstract] A study is made of the possibility of producing high strength composite materials by super high speed quenching (cooling rates up to  $3 \cdot 10^6$  C/s) of microthin wires directly from the liquid phase of the metal, fixing the high temperature state of the alloy and producing a high degree of supersaturation of the solid solution, differing significantly in its properties from the corresponding properties of stabilized structures. When microthin wires are cast in glass insulation directly from the liquid phase, the rapid cooling of the microthin wires greatly decreases the ductile properties of the alloys, but has no significant influence on strength characteristics. The tensile strength of cast microthin wires made of commercial alloys is not over  $150 \text{ kg/mm}^2$ . In order to improve the mechanical properties, the tensile strength of microthin wires of high alloys Ni-Cr-Mo-Si with large quantities of intermetallic phases was tested. An alloy was developed for casting of microthin wires with  $5\text{-}20 \mu\text{m}$  diameter, producing tensile strengths of  $250\text{-}400 \text{ kg/mm}^2$  and relative elongations of  $1.0\text{-}2.4\%$ . Figures 4; References 11: 10 Russian, 1 Western.

USSR

UDC: 678.067.5:539.32

INFLUENCE OF HEAT TREATMENT ON THE ELASTIC AND DAMPING CHARACTERISTICS OF COMPOSITE MATERIALS BASED ON ETsA RESIN

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 p 173 manuscript received 24 May 76

BIRFEL'D, A. A., YEFIMOV, I. A., POTKIN, V. V. and SHEHGOLEVA, YE. K.,  
Rybinsk Aviation Technology Institute

[Abstract of an article deposited at the All-Union Institute of Scientific and Technical Information 21 Oct 76 No 3765-76 Dep.]

[Text] Experimental studies are done on the dynamic elastic and damping characteristics of plastics based on epoxy cyanurate binder with glass, carbon and combined glass-carbon reinforcement during and after heat treatment. It is shown that heat treatment stabilizes these characteristics. Heat treatment is especially important for the multicomponent composition--glass-carbon plastic. Figures 2; References 2.

USSR

UDC: 678.067.5

A PROBABILISTIC MODEL OF DESTRUCTION OF THE BRITTLE MATRIX IN A MATERIAL  
REINFORCED BY RANDOMLY ORIENTED SHORT FIBERS

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 p 173 manuscript  
received 22 Jan 76

PALLEY, I. Z. and SHMAROV, A. N., Riga Polytechnical Institute

[Abstract of an article deposited at the All-Union Institute of Scientific  
and Technical Information 23 Dec 76, No 4506-76 Dep.]

[Text] A probabilistic model is proposed for destruction of the matrix in materials that are chaotically reinforced by short fibers. Destruction of the matrix is treated as amalgamation of random defects scattered throughout the volume into a cleavage surface. A material with brittle matrix is considered, and it is assumed that the breaking toughness of such materials is associated with the presence of barriers in the form of the reinforcing elements of the composite. Destruction of the matrix may arise from normal and tangential stresses. A series of probabilistic problems is examined: intersection of a given fiber by a single fiber and by a set of fibers, the distribution of rectilinear sections of the fracture surface, the distribution of a predetermined number of sequential breaks, and on the probabilistic measure of a random surface within predetermined boundaries. Theoretical probabilities are found for crack length as a function of concentration and length of fibers, and as a function of the matrix characteristics. An example is given illustrating calculation of the appearance of a broken section of surface. Figures 4; References 8.

USSR

UDC 678.067.5

CONDITIONS OF INTEGRITY AND RELIABILITY OF A COMPOSITE

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 156-158 manuscript  
received 27 Jan 76

KANOVICH, M. Z., KOLTUNOV, M. A. and ROGINSKIY, S. L., All-Union Scientific  
Research Institute of Glass Fiber and Fiberglass Plastics, Moskovskaya  
Oblast, Moscow Institute of Electronic Machine Building

[Russian abstract provided by the source]

[Text] Conditions of integrity and reliability of composite materials are determined from the average values of the physicomachanical and strength

characteristics, and the probability density function is found for the time that a fiberglass-reinforced plastic composite will remain intact. References: 2 Russian.

USSR

UDC: 624.074:539.3

LOSSES OF STABILITY OF REINFORCED CYLINDRICAL SHELLS UNDER HYDROSTATIC EXTERNAL PRESSURE

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 90-95 manuscript received 23 Jun 75

MILEYKO, S. T. and KONDAKOV, S. F., Institute of Solid State Physics, Academy of Sciences USSR, Moskovskaya Oblast

[Abstract] Experiments are done on filament-wound laminate cylindrical shells made by explosive forming. The shell material was grade A5 aluminum foil reinforced with chrome-nickel steel wire in different winding arrangements. The critical hydrostatic pressure of loss of stability of the shells was determined. The results show that shear effects in shells with a metal matrix do not have any appreciable influence on loss of stability even when the walls are fairly thick and the percentage content of reinforcing wire is high. The principal characteristic that determines the stability of the shell under external hydrostatic pressure is the cutting modulus of the material in the peripheral direction. When winding of the reinforcement is more complicated than simple alternation of foil and wire, the stability of the shell may be somewhat reduced by imperfections of the reinforcing technology. Figures 8; References: 6 Russian.

USSR

UDC: 624.074.4:539.3.001

PROBABILISTIC STABILITY ANALYSIS AND MINIMIZATION OF THE MASS OF CYLINDRICAL SHELLS MADE FROM A COMPOSITE MATERIAL WITH RANDOM INITIAL IMPERFECTIONS

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 80-89 manuscript received 2 Dec 75

LUKOSHEVICHYUS, R. S., RIKARDS, R. B. and TETERS, G. A., Shyaulayay Pedagogical Institute imeni K. Preykhshas, Institute of Mechanics of Polymers, Academy of Sciences Latvian SSR, Riga

[Russian abstract provided by the source]

[Text] An examination is made of the problem of stability of a multilayered reinforced orthotropic cylindrical shell under axial compression in the case where the shell has initial random deviations from the ideal shape. Expressions are given for the probability density function of the critical load and other probabilistic characteristics. The problem of minimizing mass with consideration of reliability is formulated as a nonlinear problem of stochastic programming. Numerical examples are solved. Figures 3; References: 13 Russian.

USSR

UDC: 629.7.02:539.4

CONTACT PROBLEM FOR BEAMS OF COMPOSITE MATERIALS

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 63-64 manuscript received 22 Dec 75

POLYAKOV, V. A. and ZHIGUN, I. G., Institute of Mechanics of Polymers, Academy of Sciences Latvian SSR, Riga

[Abstract] A boundary value problem is solved for a rectangular region loaded on the boundary by concentrated forces. The proposed technique gives final expressions for the stresses over the entire region including the zone of the St. Venant effect. The procedure is based on the Flamant solution for an orthotropic half-plane. A stress function that satisfies "cutout" boundary conditions is proposed in the zero approximation. The next two approximations are evaluated by the Ritz-Galerkin variational method. It is found that in beam cross sections close to the line of action of the concentrated force, the tangential stress curve differs considerably from a square-law parabola. The value of  $\tau_{\max}$  increases with a reduction in the elastic modulus  $E_y$  and with an increase in the shear modulus  $G_{xy}$ . The

stressed state is studied with respect to the parameters of anisotropy in the zone of the St. Venant effect. In the case of anisotropy parameters typical of plastics with glass and carbon reinforcement the development of positive transversal stresses  $\sigma_y$  is precluded. The region of local transversal compression has an extent of the order of the height of the beam cross section. A reduction in transversal stiffness of the material reduces the maximum tensile stresses  $\sigma_x$ . Figures 6; References 9: 8 Russian, 1 Western.

USSR

UDC: 629.7.02:539.4

ANALYSIS OF THE DISTRIBUTION OF TANGENTIAL STRESSES IN THREE-POINT BENDING OF BEAMS MADE FROM COMPOSITES

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 56-62 manuscript received 22 Dec 75

TARNOPOL'SKIY, YU. M., ZHIGUN, I. G. and POLYAKOV, V. A., Institute of Mechanics of Polymers, Academy of Sciences Latvian SSR, Riga

[Russian abstract provided by the source]

[Text] It is shown that determination of interlayer shear strength of composite materials by three-point bending of short beams with different ratios of span to height of the specimen gives results that are incompatible with one another. To establish the causes of this discrepancy, the authors analyze the distribution of tangential stresses that arise when short beams bend under the action of concentrated forces. An expression for stress  $\tau_{xy}$  is used that is obtained with consideration of the singularities of the stressed state that arises in the vicinity of points of application of the concentrated forces. An investigation is made of the influence that anisotropy of the elastic properties of the material has on the change in maximum tangential stresses. An estimate is made of the possibility of destruction by peeling apart in zones of compression. Figures 5; References 16: 10 Russian, 6 Western.

USSR

UDC: 678.067.5:539.4

REDISTRIBUTION OF STRESSES WHEN BRITTLE FIBERS BREAK IN METAL COMPOSITE MATERIALS

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 19-29 manuscript received 18 May 76

OVCHINSKIY, A. S., KOP'YEV, I. M., SAKHAROVA, YE. M. and MOSKVITIN, V. V., Institute of Metallurgy imeni A. A. Baykov, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] A computational model is worked out for stress redistribution in composite materials as individual fibers are destroyed. The model is based on the hypothesis of shear strains in the matrix at interfaces with fibers, which is generalized to the case of a many-fiber model and elastic-plastic deformation of the matrix. Expressions are derived that describe the distribution of tensile stresses and axial displacements in the broken fiber and those adjacent to it, as well as the distribution of shear strains and tangential stresses in the matrix along the fiber boundaries as a function of the ratio of elastic and ductile properties of the components, the volumetric proportions of the components and the load level. The resultant relations are used to analyze stress distribution in boron-aluminum composites. Figures 9; References 10: 5 Russian, 5 Western.

USSR

UDC 539.4:539.62:678

INFLUENCE OF THE DEGREE OF DISPERSITY OF THE FILLER ON WEAR RESISTANCE OF COMPOSITES BASED ON POLYETHYLENE

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 45-49 manuscript received 2 Feb 76

AYNBINDER, S. B. and ANDREYEVA, N. G., Institute of Mechanics of Polymers, Academy of Sciences Latvian SSR

[Abstract] An investigation is made of the influence that particle size and content of filler have on wear of composites based on high-density polyethylene. It is found that the degree of dispersity of the filler has a considerable effect on wear of composites. Other things being equal (hardness of the filler, its percent concentration, roughness of the other member of the friction couple), the larger the filler particles, the lower the wear of the composites. However, there is an optimum particle size that may be different for different fillers: the harder the filler, the smaller the optimum particle size. For instance when iron powder is used, minimum wear



corresponds to particle size of 315-630  $\mu\text{m}$  (and maximum wear to 50  $\mu\text{m}$ ). On the other hand an abrasive filler such as aluminum oxide has a much smaller optimum size--less than 50  $\mu\text{m}$ . The effect of filler dispersity is particularly pronounced during wear-in. As the duration of testing increases, wear falls off, and when a steady state is reached, wear of composites is only slightly dependent on particle size and amounts to 0.0001-0.0004  $\text{cm}^3$  for every two hours of operation. However, the overall wear pattern with time still shows differences, and is actually determined by the wear-in period. In the general case the wear resistance of the composites depends on the hardness of the filler, and increases with increasing hardness. The harder the filler, the less the wear depends on the initial roughness of the other member of the friction couple. The parameters of wear depend on the initial roughness of the other member of the friction couple (the quantity  $\sigma'$ ). The greater the  $\sigma'$ , the higher the wear of the composites will be. However, the influence of  $\sigma'$  differs in the first place for composites with different degrees of dispersity, and secondly on different stages of work. The finer the filler, the sharper the dependence of wear on  $\sigma'$ , such composites being extremely sensitive to slight changes in the roughness of the other member of the friction couple. The initial value of  $\sigma'$  has an appreciable effect on wear parameters during wear-in, and little effect in steady-state operation. However, roughness cannot be taken as an exhaustive characteristic for describing the wear of polymer composites since in many instances composites show a considerably different wear pattern under identical conditions. Figures 7; References 8: 7 Russian, 1 Western.

USSR

UDC 538.4:669.017

# STUDY OF THE POSSIBILITY OF PRODUCING COMPOSITE MATERIALS UNDER CONDITIONS COMPENSATING FOR THE EFFECTS OF THE FORCE OF GRAVITY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234 No 1, May/June 77  
pp 61-64 manuscript received 20 Nov 76

GEL'FGAT, YU. M., SORKIN, M. Z., MIKEL'SON, A. E., Institute of Physics, Academy of Sciences LatvSSR

[Abstract] The creation of new alloys, including alloys of metals with an extensive area of layer separation, is one promising trend in the technology of the production of materials with new usage properties. The interaction of the alloys in the liquid state with the force of gravity is a hindrance in this work. Therefore, plans have been published for alloying of metals onboard spacecraft in orbit, etc. It is also possible, however, to create the equivalent of weightless conditions by exposing conducting metals to electromagnetic fields which compensate for the force of gravity. An experimental check of the possibility of using this method is conducted in this article. A melt was used consisting of two immiscible metals--zinc

and lead--containing 5 to 75% lead. It was found that the use of electromagnetic forces can serve as an effective means for producing homogeneous alloys of metals which normally separate into layers, but that in many cases, including the case of lead and zinc, it is necessary to excite mixing flow in the melt by changing the shape of the electrodes in order to achieve good distribution of both metals throughout the volume of the crucible. Figures 4; References 6: 4 Russian, 2 Western.

USSR

UDC 539.4:621.791

THE LIMITING STRESS STATE AND LOAD-BEARING CAPACITY OF A MULTILAYER COMPOSITE SOFT INTERLAYER

Kiev PROBLEMY PROCHNOSTI in Russian No 3 (93) Mar 77 pp 74-76 manuscript received 15 Apr 76

ZAYNULLIN, R. S., Ufa Petroleum Institute

[Abstract] This work presents a study of the stress state and load-bearing capacity of a multilayer composite interlayer in tension (compression) under conditions of planar deformation. The deformation of a thin composite interlayer consisting of an arbitrary number of layers differing in their yield point and acting as ideally rigid-plastic materials is studied. The specimen plan used with a composite interlayer is characteristic for welded joints made with electrodes with various viscous-plastic properties. Formulas are produced to estimate the stresses and load-bearing capacity of a multilayer composite interlayer in tension or compression. The formulas are tested experimentally by production of Moire bands in a five-layer composite utilizing two types of solder as the soft layers and steel plates of type 45 steel as the hard layer. Figures 5; References: 10 Russian.

USSR

UDC 669.14/.15.018.29

QUANTITATIVE ESTIMATE OF THE DEFORMATION STRUCTURE OF BIMETALLIC COMPOSITES

Moscow PRAKTIKA TEPLOVOY MIKROSKOPII in Russian, Nauka Press 1976 pp 90-93

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31457 by the Authors]

TANANOV, A. I., BUKATIN, O. V.

[Text] Results are presented from studies of the process of accumulation of plastic deformation in the transient zones of a bimetal consisting of type

3 steel + KHI8N10T stainless steel under cyclical loading conditions in an IMASH-10-68 test machine. The tests were performed using a combined method based on the use of automatic pattern analyzers. Figures 5, References 2.

USSR

UDC 669.127.3:539

#### STRENGTH PROPERTIES OF THREADLIKE CRYSTALS PRODUCED FROM AGMK SLAGS

NAUCH. SOOBShCH. N.-i. I PROYEKT. IN-T TSVET. METALLURGII "ARMNIPROTSVETMET" in Russian No 2(18) 1976 pp 32-33

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31438 by V. Olenicheva]

AYVAZIAN, V. T., SIRAKANYAN, M. O., MNATSAKANYAN, S. A., ASATRYAN, G. A.

[Text] A study is made of the properties of threadlike crystals (TC) of Fe grown from chlorides produced from waste slag from the production of copper. The maximum tensile strength for Fe-TC is  $600 \text{ kg/mm}^2$  with a diameter of  $3 \mu\text{m}$ . Considerable variation is observed in strength as a function of diameter of the TC. In specimens over  $30\text{--}40 \mu\text{m}$  in diameter, the strength of the TC agrees with the strength of massive crystals and only beginning at approximately  $15 \mu\text{m}$  does it increase rapidly, approaching the theoretical strength of the material. The strengthening effect is particularly noticeable in iron alloy TC. With a 5% Cr content, TC  $30 \mu\text{m}$  in diameter have a tensile strength of  $230 \text{ kg/mm}^2$ , some three times stronger than the strength of Fe TC. Alloyed TC show the scale factor less, and with an increasing content of the alloying element this tendency decreases. With 5% Cr, the greatest tensile strength for TC  $4 \mu\text{m}$  in diameter is  $320 \text{ kg/mm}^2$ , while TC  $100 \mu\text{m}$  in diameter show a tensile strength of  $150 \text{ kg/mm}^2$ . For Fe TC the figures are 560 and  $37 \text{ kg/mm}^2$ , respectively.

USSR

UDC 666.762.6.001.5

#### CREATION OF A COMPOSITE MATERIAL BASED ON YTTRIUM OXIDE

Moscow OGNEUPORY in Russian No 3, 1977 pp 53-55

KRYLOV, Yu. I.

[Abstract] This article is dedicated to development of a high temperature yttrium ceramic with high thermal stability by introduction of a metal-like refractory compound--titanium diboride. The primary task of the study was investigation of the first stage in the creation of composite thermostable

inorganic materials based on the system  $\text{TiB}_2\text{-Y}_2\text{O}_3$ , namely investigation of the high temperature compatibility of the components of the system and estimation of the possibility of producing a material in this system by known technological methods. The possibility was established of producing a compact yttrium ceramic (relative density 95-98%) by introduction of  $\text{TiB}_2$  20-30% and sintering in a vacuum at 1600-1700°C or hot pressing at 1500°C. It is assumed that the increase in density of the material is achieved by formation of reaction products as a result of interaction of components in the system. Figures 5; References: 4 Russian.

## Conferences

USSR

UDC 621.73:061.3

ALL-UNION SCIENTIFIC AND TECHNICAL CONFERENCE "ELECTRIC DISCHARGE IN FLUIDS AND ITS APPLICATION IN MACHINE BUILDING AND METAL WORKING TECHNOLOGY"

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 3, Mar 77 p 48

MAZUROVSKIY, B. YA., MESHCHERINA, S. P.

[Abstract] The conference mentioned in the title was held in Nikolayevo in September of 1976. The conference was attended by representatives of organizations and enterprises of many cities in the USSR, as well as numerous research institutes and educational institutions. The four sections of the conference heard some 200 reports, including over 40 in the section on "Impulse Pressure Working of Metals." Subjects covered included the main paths of development of the technology and equipment for electric impulse pressure working of metals, standardization of this equipment and organization of its series production; the design and technological capabilities of the model T1223 press, to be put in series production; the influence of various factors on the technological parameters of electrohydrodynamic shaping; the prospects for the use of electrohydrodynamic stamping for the manufacture of complex sheet parts; theoretical analysis of various versions of the process of high speed deformation; electrohydrodynamic shaping of welded shells; measurement of deformations in structural elements of electrohydrodynamic presses; the economic effectiveness of the method; electrohydrodynamic broaching of apertures; stamping of artistic products; and stamping of parts of complex shapes.

USSR

UDC 620.199

MODELING ATMOSPHERIC CORROSION OF METALS IN AN ARTIFICIAL CLIMATE CHAMBER  
AND ACCELERATING IT BY MEANS OF RAISING THE TEMPERATURE

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar/Apr 77 pp 159-163  
manuscript received 5 Aug 75

SHUVAKHINA, L. A., MIKHAYLOVSKIY, YU. N., SHARONOVA, N. F. and SEDOVA, V. S.  
Academy of Sciences USSR, Institute of Physical Chemistry

[Abstract] The authors present data on investigations conducted on the influence of temperature on the corrosion rate of iron, zinc, cadmium and copper in a pure moist temperature and in the presence of a thin phase film of water on the metal. They determined the coefficients of acceleration of corrosion with elevation in temperature. They demonstrated how much the corrosion process can be accelerated on the test metals as far as real conditions are concerned by conducting the tests in artificial climate chambers at a temperature of 40-60°. Figures; References: 9 Russian.

USSR

UDC 620.193.01

INCREASING THE PASSIVITY AND CORROSION RESISTANCE OF TITANIUM BY SURFACE  
DOPING WITH PALLADIUM

Moscow ZASHCHITA METALLOV in Russian, Vol 13, No 2, Mar-Apr 77 pp 164-169  
manuscript received 25 Jul 75

TOMASHOV, N. D., CHERNOVA, G. P. and FEDOSEYEVA, T. A., Academy of  
Sciences USSR, Institute of Physical Chemistry

[Abstract] This work deals with a study of the electrochemical behavior and corrosion resistance of titanium doped with palladium from the surface by the electrodeposition of thin films of palladium on the surface of a titanium sample and subsequent diffusion annealing. The authors established that a palladium cathode-modified titanium surface has a higher corrosion resistance in  $H_2SO_4$  and HCl than the alloy Ti+0.2% Pd. Figures 3; References 3: 2 Russian, 1 Western.

USSR

UDC 620.193.01

ELECTROCHEMICAL INVESTIGATION OF THE CORROSION RESISTANCE OF TITANIUM-ALUMINUM ALLOYS IN 10% HYDROCHLORIC ACID

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar/Apr 77 pp 183-185  
manuscript received 3 Nov 75

BEREZHKO, A. V., CHERNYSHEVA, S. P., SHAPOVALOVA, O. M., KORNILOV, I. I., (deceased) and NARTOVA, T. T., All-Union Titanium Scientific Research and Design Institute

[Abstract] Doping titanium with aluminum leads to a reduction in its corrosion resistance. The authors investigate the electrochemical behavior of titanium doped with 0 to 22% concentration of aluminum at room temperature in a 10% solution of hydrochloric acid where titanium is found to be at the boundary of the passive state. Their investigations demonstrate that the allowable concentration of aluminum in titanium alloys used in aggressive media at room temperature is 3%. Figures 1; References: 7 Russian.

USSR

UDC 621.039.531

CORROSION OF STEEL IN WATER WITH AN ELEVATED AMOUNT OF CHLORIDES UNDER IRRADIATION CONDITIONS

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar/Apr 77 pp 185-188  
manuscript received 16 Jun 75

ALEKSEYENKO, N. N., RAZOV, I. A. and USATOV, E. P.

[Abstract] The authors studied the accelerating influence of neutron bombardment on the resistance of certain steels in water with a 24 g/l content of chlorine ions at a temperature of 20-40°. They investigated ferrite-perlite chrome-nickel-molybdenum steels, manganese austenite and chrome-nickel austenite steels. The tendency to passivation can be explained by the fact that the dependence of corrosion rate on neutron flux density in manganese austenite steels is a weak one. Figures 2; References: 9 Russian.



USSR

UDC 620.193.01

MECHANISM OF THE INHIBITING EFFECT OF ORTHOPHOSPHORIC ACID ON THE  
CORROSION OF ALUMINUM ALLOYS IN HIGH-TEMPERATURE WATER

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar/Apr 77 pp 206-209  
manuscript received 28 Nov 75

ROZENFEL'D, I. L., LOMAKINA, S. V. and OL'KHOVNIKOV, YU. P., Academy of  
Sciences USSR. Institute of Physical Chemistry

[Abstract] The authors investigate the mechanism of the effect of small additives of orthophosphoric acid on the corrosion of certain alloys in distilled water at a temperature of 200 and 250°. To do so they used electrochemical methods which they developed for corrosion processes in high-temperature water. Phosphate ion modification of the film leads to the onset of external layers with a special structure and properties which facilitate a decrease in counter migration of reacting particles in the film and thus the oxidation rate. Figures 3; References 6: 4 Russian, 2 Western.

USSR

UDC 620.193.01

X-RAY INVESTIGATION OF ATMOSPHERIC CORROSION INHIBITORS ON METAL SURFACES

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar-Apr 77 pp 209-212  
manuscript received 4 May 75

NOVITSKIY, A. N., SALYN', YA. V. and NEFEDOV, V. I., Academy of Sciences  
USSR, Institute of General and Inorganic Chemistry

[Abstract] The authors use x-ray spectroscopy as a promising method of studying changes in the surface of a material as a result of corrosion. This method allows study of a comparatively thin surface layer of materials and can be employed because of the relative constancy of the bonding energy of atoms appearing in the functional groups. The surfaces of all the metals studied are coated with oxides and consequently inhibitor adsorption takes place on the oxides rather than on the metals. Figures 1; References 3: 2 Russian, 1 Western.

USSR

UDC 621.357.7

INFLUENCE OF A PERIODIC CURRENT ON THE STRUCTURE AND PHYSICO-MECHANICAL PROPERTIES OF AN ELECTROLYTIC TUNGSTEN-COBALT ALLOY

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar-Apr 77 pp 238-240  
manuscript received 26 Nov 75

MALYAKINA, A. G., SHAMAYEVA, A. D. and FOMICHEV, V. T., Volgograd Structural Engineering Institute

[Abstract] The authors investigated the influence of a periodic current produced by a vertical cutoff of a direct (cathode) current impulse of industrial frequency on the structure, hardness and internal stresses of electrolytic tungsten-cobalt alloys. They discovered that the utilization of periodic currents during electrodeposition of the tungsten-cobalt alloys allows production of amorphous alloys from an ordinary electrolyte with an unusual ratio of physico-mechanical properties. Figures 2; References 9: 7 Russian, 2 Western.

USSR

UDC 620.193.01

FORMATION AND STRUCTURE OF BARRIER-TYPE ANODE OXIDE FILMS ON BERYLLIUM

Moscow ZASHCHITA METALLOV in Russian Vol 13, No 2, Mar-Apr 77 pp 245-247  
manuscript received 21 Jul 75

CHERNYSHEV, V. V. and VOL'FSON, A. I., Voronezh State University

[Abstract] Beryllium can be protected from the effects of an external atmosphere by anodizing in aqueous solutions containing an oxidizing anion; however, the anode films produced have a porous structure and only the very thin barrier layer immediately adjacent to the metal has no pores. It is this layer which prevents the metal surface from contacting the surrounding atmosphere. The authors cite data on production of solid anode films on beryllium in an electrolyte proposed by them. They find that the interplanar distances corresponding to the electron diffraction lines agree well with those found by x-ray; they characterize the hexagonal BeO lattice with periods  $a = 0.270$  and  $c = 0.438$  nm. Figures 3; References: 8 Russian.

USSR

UDC 621.73.011.001.5

## ESTIMATE OF THE DEFORMATION CAPACITY OF METALS UPON PRESSURE WORKING

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 3, Mar 77  
pp 15-18

OGORODNIKOV, V. A.

[Abstract] This article is dedicated to further development of methods of calculation estimation of the deformability of metals without rupture and application of these methods to specific technological processes of volumetric deformation. Construction of plasticity diagrams was accompanied by tests in which parameter  $\eta$  remained constant. The experiments were programmed in the space of deformations. This resulted in the production of diagrams of the plasticity of the steels, brass and duralumin tested. The method presented for calculation of the deformability of metals and alloys during pressure working can be used for the planning of technological processes of rotary compression, transverse extrusion, cold closed impression dye forging, etc. The nomograms and formulas produced in this work can be practically applied. The criterion of deformability suggested allows the maximum permissible parameters of technological processes accompanied by three-dimensional stress states and complex loading to be calculated. Figures 6; References: 8 Russian.

USSR

UDC 621.73.042

## STUDY OF THERMOMECHANICAL MODES OF DRAWING AND THE STRUCTURE OF THE FORGINGS OF ROTORS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 3, Mar 77  
pp 18-19

ONISHCHENKO, A. K., VERETENNIKOV, E. V.

[Abstract] A description is presented of a study of the structure of the metal in the central zone of rotors 1300-2000 mm in diameter (steel types 35KhN3NFA and 25KhN3MFA) immediately after preliminary heat treatment, including phase recrystallization at 880-900°C. Analysis of the microstructure showed that these steels manifest structural heredity in the retention of the austenitic large grain, not corrected after one-time recrystallization. In order to produce a fine-grain structure throughout the volume of the forging while retaining the cycle of heat treatment, in the concluding operations of drawing of rotor blanks it is necessary to regulate strictly not only the temperature of plastic deformation, but also the absolute compression per press stroke. Figures 3; References 5: 4 Russian and 1 Japanese.

## Graphite

USSR

UDC 546-26-162:539.1.04

### MICROPOROSITY AND IRREVERSIBLE CHANGES IN THE PROPERTIES OF HEAVILY IRRADIATED GRAPHITE

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 4, Apr 77 pp 752-753 manuscript received 27 Nov 75

VIRGIL'YEV, YU. S., KUROLENKIN, YE. I. and SHURSHAKOVA, T. N.

[Abstract] The structural porosity of heavily irradiated graphite was studied by a technique involving scattering of x-rays at low angles with simultaneous determination of the change in parameters of the crystal structure, electrical resistance and length of the specimens. The specimens were isothermally annealed at successively higher temperatures with holding at each one for an hour. Grade GMZ graphite was used with irradiation by 0.18 MeV neutrons in a dose of about  $7 \cdot 10^{21}/\text{cm}^2$ . Exposure was at 100-150 and 700-800°C. Annealing of the heavily irradiated specimens reduced the pore volume regardless of the exposure temperature, and the change was found to be irreversible even with annealing to the graphitizing temperature of 2300°C. Figures 2, References: 7 Russian.

USSR

UDC 621.3.035.2

### INCREASING THE STRENGTH OF GRAPHITE BY SATURATION

Moscow TSIVETNYYE METALLY in Russian No 3, Mar 77 pp 41-43

POLISAR, E. L.

[Abstract] A model is suggested for calculation of the increase in strength of artificial graphites as a result of saturation. Experimental testing of the model performed on specimens of type GMZ-MT graphite with various cross-sectional dimensions showed good agreement with calculation results. The method of least squares was used to determine the constants of the equation relating the strength of GMZ-MT graphite in bending to the porosity of the graphitized binder. The results of this work, as well as others, also lead to the conclusion that the form factor K is determined entirely by the properties of the filler, since it was found to be independent of the content of binder in the initial mass for pressing and the quantity of impregnate filling the pores of the material saturated. Figures 1; References: 5 Russian.

## METHOD OF TESTING GRAPHITE FOR BREAKING STRENGTH

Moscow ZAVODSKAYA LABORATORIYA in Russian No 1, Jan 77 pp 89-91 manuscript received 20 Feb 76

SAZHIN, A. N., KUZNETSOV, A. V., LYSHOV, L. L., BARABANOV, V. N.

[Abstract] Four types of graphite--MPG-8, VPP, MG-1, and PROG-2400--were tested for breaking strength. The selected types represent all the domestic graphites. Specimens of graphite 15 x 30 x 150 mm and 10 x 20 x 120 mm were tested on the Instron-500 machine. Breaking strength  $K_{JC}$  was calculated from the following formula:  $K_{JC} = Y \frac{6Ml^{1/2}}{tb}$ , where Y-coefficient

of K-calibration obtained from a Western source (listed in the bibliography); M-bending moment in kgs mm; l-depth of notch; b-width of specimen in mm; and t-thickness of specimen in mm. The dependencies of  $K_{JC}$  and of the breaking load on the relative depth of the notch and the radius at the top of the notch were investigated. Optimal values for the radius and depth of the notch were established for the tested types of graphite. Figures 2; References 4: 3 Russian, 1 Western.

USSR

UDC 669.721.5:620.17

INFLUENCE OF HEAT TREATMENT ON THE STABILITY OF CASTING DIMENSIONS AND THE MECHANICAL PROPERTIES OF THE ML19 ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1977 pp 70-71

TIKHOVA, N. M., BLOKHINA, V. A., and ANTIPOVA, A. P., All-Union Scientific Research Institute of Aviation Materials

[Abstract] The authors investigate the influence of different regimes of heat treatment on the amount of permanent stresses in test castings, the so-called rectangular shrinkage lattices. They established that the most effective reduction in internal stresses is achieved as a result of high-temperature annealing of castings at 420-450°C, with cooling in the furnace or in air. They also demonstrated that high-temperature annealing of quenched and aged samples reduces the tensile strength and yield stress of the alloy at 20°C by 20-25% and doubles the linear expansion. Preliminary high-temperature annealing exerts no influence on the mechanical properties of the alloy after quenching and aging and therefore may be recommended for removing internal stresses prior to welding the defects or before straightening. Figures 1.

## Magnesium

USSR

UDC 669.721.5.018.44

### A HEAT RESISTANT MAGNESIUM CASTING ALLOY

VESTNIK MASHINOSTROYENIYA in Russian No 12, 1976 p 77

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31632 by V. Bochkareva]

UNSIGNED

[Text] The alloy is designed for the manufacture of loaded cast parts operating for long periods of time at temperatures up to 300°C and briefly up to 400°C. The mechanical properties of the alloy at 300°C are:  $\sigma_{0.2}$  10 kg/mm<sup>2</sup>,  $\sigma_b$  15 kg/mm<sup>2</sup>,  $\delta$  10%. One significant advantage of the alloy is the absence in its composition of toxic and radioactive additives. The use of the alloy allows the maximum working temperature of the part to be increased by 1.5-2 times, decreasing the mass of the structure in comparison to Al and Ti alloys by 10-30%. The alloy is patented.

USSR

UDC 669.721:66.041.22

### INTERACTION BETWEEN MAGNESIUM AND GASES

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3 1977, pp 52-55

ALEKSANDROVA, YU. P. and ROSHCHINA, I. N., Moscow Aviation Technology Institute

[Abstract] The authors investigated the interaction between magnesium and gases of the protective atmosphere: SO<sub>2</sub>, SF<sub>6</sub>, N<sub>2</sub>, CO<sub>2</sub>. They developed a procedure for the experiment and conducted physicochemical investigations of protective films forming on the mirror surface of the molten metal. They clarified the laws governing the kinetics of film growth as a function of the composition of gas protective media. The authors established that protective films at 750°C are formed in the gas atmosphere consisting of N<sub>2</sub>+CO<sub>2</sub> and also in atmospheres containing no less than 1.5 vol% SF<sub>6</sub>.

Figures 8; References: 5 Western.



## Mechanical Properties

USSR

UDC 669.71'295'296:669.018.2

INFLUENCE OF TUNGSTEN ON THE MECHANICAL PROPERTIES OF THE ALLOY Ti-3Al-3Zr

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 210-212 manuscript received 19 Dec 75

KORNIKOV, I. I. (deceased), NARTOVA, T. T., GRIGOR'YEV, I. P., Moscow

[Abstract] A study is made of the influence of tungsten on the mechanical properties of a ternary  $\alpha$ -solid solution in the system Ti-Al-Zr after various types of heat treatment. The alloy selected for study contained 3 wt.% Al and 3 wt.% Zr. It was found that as the concentration of tungsten was increased, the strength, hardness and resistivity increased. Near the maximum solubility of tungsten in  $\alpha$  titanium, a gentle maximum is observed on the curves of properties versus composition. The minimum of the properties corresponds to a content of 1 wt.% W in the alloys. With a weight content of 3-3.5% tungsten, the alloys have high strength, approximately 100 kg/mm<sup>2</sup> at 20°C with  $\delta$  = 12-15%. The favorable influence of tungsten on the hardening of  $\alpha$  titanium is retained in the alloys Ti+3Al+3Zr+W up to 600°C. The strength after annealing at 800°C for 100 hrs is higher than after annealing at 900°C for 20 hrs. Figures 4; References: 3 Russian.

USSR

UDC 620.171.5:669.12'27'28

INVESTIGATION OF THE MICRODEFORMED STATE OF SINTERED COMPOSITE MATERIALS  
BY THE POLARIZATION-OPTICAL METHOD

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3(171) Mar 77 pp 71-75  
manuscript received 27 Jul 76

GOLOVIN, S. A., GRINBERG, YE. M., KUZ'MINA, N. YE. and RENNE, I. I.,  
Tula Polytechnic Institute

[Abstract] Using the method of photoelastic coatings the authors investigated the character of the deformation distributions on microsegments of iron based composite materials produced by the method of sintering and impregnation. They studied the features of development of microheterogeneity of the deformed state of composite materials with different amounts of carbon in the iron shell. Figures 2; References: 5 Russian.

USSR

UDC 621.9.048.4

INFLUENCE OF THE PROPERTIES OF CARBIDES ON EROSION RESISTANCE IN REGIMES  
OF ELECTROSPARK TREATMENT

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3(171) Mar 77 pp 55-60  
manuscript received 28 Nov 75

SAMSONOV, G. V., MUKHA, I. M., VERKHOTUROV, A. D., TKACHENKO, YU. G. and BOVKUN, G. A., Institute of Problems of Material Science, Academy of Sciences Ukrainian SSR

[Abstract] The authors made a systematic investigation of the erosion of metal carbides of groups IV-VI with spark dimensional treatment, electrospark alloying, electron beam treatment and effect of the glow discharge. They established that under the effect of a glow discharge the erosion resistance is maximum for metal carbides of group IV and is reduced with transition to carbides of groups V and VI, i.e., for carbides with high thermophysical properties it is higher. If there is an impulse effect from the electron flux (in the process of spark dimensional treatment, electrospark alloying, electron beam treatment), the erosion resistance of the carbides is increased upon transition from metal carbide of group IV to metal carbides of groups V and VI, i.e., in these cases it correlates with the mechanical properties of the carbides, mainly with their brittleness. Analysis of the brittleness of carbides during micromechanical tests involving indentation and scratching showed that its values are decreased in this direction. Figures 2; References 14: 13 Russian, 1 Western.

USSR

UDC 621.762:669.018.25(088.8)

A SINTERED TOOL MATERIAL

USSR AUTHOR'S CERTIFICATE NO 505733, FILED 24/06/74, NO. 2037841,  
PUBLISHED 7/07/76 in Russian

[From REFERATIVNYY ZHURNAL, METALLURGIYA NO 3, 1977 Abstract No 3G514P]

KIPARISOV, S. S., MEYERSON, G. A., PANOV, V. S., ROMANENKO, A. V.,  
TRET'YAKOV, V. I., SMIRNOVA, M. M., Moscow Institute of Steels and Alloys,  
All-Union Scientific Research Institute for Hard Alloys

[Text] A sintered tool material is suggested, based on high speed steel, containing a compound of C with a refractory metal selected from the group including Nb. In order to increase strength, cutting life and wear resistance, the compound of C with the refractory metal used is a metal carbonitride taken from the group containing Ti, V and Nb with the following relationship between components: metal carbonitride selected from the group containing T, V, Nb 3-10%, high speed steel--remainder. 1 table.

USSR

UDC 621.762:669.018.95(088.8)

A METHOD OF MANUFACTURING A CERAMETALLIC MATERIAL

USSR AUTHOR'S CERTIFICATE NO. 506468, FILED 17/08/73, NO 1956081,  
PUBLISHED 10/05/76 in Russian

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 3G524P by  
T. Kozlovskaya]

KISLYY, P. S., KUZENKOVA, M. A., BELYKH, A. B.

[Text] A method is suggested for manufacturing a cerametallic material based on a metal oxide, for example an oxide of Cr and/or  $Al_2O_3$ , by pressing of a blank and subsequent sintering in a vacuum of neutral gas. In order to increase the mechanical strength and thermal stability, CrC is added to the initial charge, and the temperature rise is in stages: first to 1200-1250°C, then to 1400-1450°C, after that to the sintering temperature with holding at each stage for 30-40 minutes. The invention relates to the area of cerametallic refractory materials produced by methods of powder metallurgy, which can be used in high-temperature equipment as a material having high thermal stability, high mechanical strength and corrosion resistance.

USSR

UDC 621.762.002.5(088.8)

A DEVICE FOR PRODUCTION OF METAL POWDERS

USSR AUTHOR'S CERTIFICATE NO 505754, FILED 28/10/74, NO. 2073722,  
PUBLISHED 10/05/76 in Russian

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 3G528P]

BONDARENKO, A. V., KUKOV, F. I., PARYKIN, V. S., MOROZOVA, M. YE.,  
Novocherkassk Polytechnical Institute

[Text] A device is suggested for the production of metal powders, including an electrolyzer with rotating disc cathodes made in the form of individual sections installed on a common shaft, receivers for collection of powder and washing of the fluid, as well as a shaft drive. In order to increase the quality of the powders produced, it is equipped with a mechanism for individual movement of sections, connected to the shaft by means of L-shaped holders, while the receivers for collection of the powder and wash fluid are located between the cathodes in the upper portion of the electrolyzer. 2 figures.

USSR

UDC 546.623'171.1:666.3

CREEP OF ALUMINUM NITRIDE DURING HOT PRESSING

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 2, Feb 77 pp 262-265 manuscript received 24 Nov 75

SPIVAK, I. I. and RYSTSOV, V. N.

[Abstract] A study is made of the hot pressing of AlN. Based on concepts of the mechanism of compacting involving processes of creep in the final stages of hot pressing, the authors determine the parameters of creep in direct experiments. The kinetics of hot pressing of AlN were studied in the 1500-1900°C interval at pressures of up to 400 kg/cm<sup>2</sup>. Compact materials can be produced at pressing temperatures of 1800°C. The parameters Q and D of creep of AlN were determined for the case of the diffusion mechanism of creep. In the final stages of compacting of AlN during hot pressing, the diffusion creep mechanism predominates. Figures 4; References 13: 6 Russian, 7 Western.

## EXPERIMENTAL INVESTIGATION OF THERMAL AND ELECTRICAL CONDUCTIVITY OF MATERIALS OF METAL FIBERS

Kiev POROSHKOVAYA METALLURGIYA in Russian, No 3(171 , March 1977 pp 45-49  
manuscript received 14 Jun 74

KOSTORNOV, A. G., SHEVCHUK, M. S., LEZHENIN, F. F. and FEDORCHENKO, I. M.,  
Institute of Problems of Material Science, Academy of Sciences Ukrainian  
SSR, Institute of Technical Thermophysics, Academy of Sciences Ukrainian  
SSR

[Abstract] The authors cite experimental data on thermal and electrical conductivity of porous materials, made of Kh20N80 nichrome and 1Kh18N9T stainless steel fibers in the temperature range of 20-1000°C. They investigated the dependence of electrical conductivity of materials with a porosity of 10-80% on the sintering temperature and diameter of the original fibers. The authors demonstrated that the electrical conductivity of porous materials of metal fibers after sintering comprises no less than 55-70% of the ideal electrical conductivity of a porous material. Figures 4;  
References: 6 Russian.

USSR

UDC 666.762,14,017:620.186

FUSED KAOLIN AND ITS PROPERTIES

Moscow OGNEUPORY in Russian No 2, 1977 pp 32-39

PITAK, N. V., SHULYAK, R. S., ZHUKOVA, Z. D., KHMELENKO, T. P., FEDORUK, R. M., Ukrainian Scientific Research Institute for Refractories

[Abstract] Results are presented from a study of fused kaolin, and the changes in its properties under the influence of the gas medium, slag and alkalis are described. The initial material used was novoselitskiy kaolin containing 48%  $Al_2O_3$ . The kaolin was melted in a single phase electric arc furnace rated at 350 kVA, primary voltage 6000 V, low side voltage 160 V, maximum current 3900 A. Electrode diameter was 150 mm. The kaolin was melted in a metal, water-cooled bath. The weight of the block fused was 500 kg. Fused kaolin has high resistance to the effects of reducing media such as synthetic slags used in primary blast furnaces and alkaline vapors at 1400°C. Figures 6; References 9: 8 Russian, 1 Western.

## Single Crystals

USSR

UDC 669.018.06

### STUDY OF NIOBIUM SINGLE CRYSTALS BY METHODS OF NUCLEAR PHYSICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 1, May-Jun 77  
pp 65-68 manuscript received 8 Jun 76

DIDENKO, A. N., SAVITSKIY, YE. M., SEVRYUKOVA, L. M., MYZENKOVA, L. F.,  
Institute of Metallurgy imeni A. A. Baykov, Acad. Sci. USSR Moscow

[Abstract] One important problem in the production of high purity niobium single crystals is the development of methods for determination of small microquantities of various impurities. This work is dedicated to the investigation of the capabilities of nuclear physical methods for the determination of the concentration of impurities of certain light and heavy elements in various stages of the technological process of production of niobium single crystals by the method of cathode-ray melting as a function of the technological manufacturing modes. Methods used included neutron activation analysis, Auger electron spectroscopy, based on the analysis of the energy spectra of Auger electrons liberated by atoms under the influence of UV, x-ray or electron radiation and by  $\alpha$  particle resonant back scattering. Combined utilization of methods of nuclear physical analysis allowed determination of the peculiarities of distribution of the impurities Ta, Fe, S and C as a number of passes of the melting zone and establish the reduction in the content of these impurities in single crystals in comparison to the initial material. Figures 2; References: 9 Russian.

USSR

UDC 669.782:621:315.59

### IMPROVEMENT OF THE TECHNOLOGY OF PRODUCTION OF SINGLE CRYSTALS BY THE CHOKHRAL'SKIY METHOD

Moscow TSVETNYYE METALLY in Russian No 3, Mar 77 pp 53-54

STOPKEVICH, V. V., VOLOBUYEV, YE. V., VESELIN, YU. N., DEGTYARIK, N. V.

[Abstract] A study is made of the problems of the influence of parameters of the process of extraction of a silicon single crystal on the distribution of alloying impurities and the resistivity through the volume of the ingot. The necessary level of automation of the withdrawing installation and requirements on accuracy of automatic systems controlling the basic parameters of the process of withdrawing the single crystal analyzed in this work have varying degrees of influence on the results of the operation. The installation for withdrawing the single crystal should be equipped with the following automatic control system: rate of withdrawing (level of error of control not over  $\pm 2\%$ ); rate of rotation ( $\pm 5\%$ ); diameter of ingot ( $\pm 2\%$ ); evaporation of impurities ( $\pm 5\%$ ); and temperature ( $\pm 0.3^\circ\text{C}$ ). Figures 4.

USSR

UDC 669.187.26

IMPROVEMENT OF TECHNOLOGY OF COOLING AND HEAT TREATMENT OF ESR AND VAR INGOTS OF HIGH-STRENGTH STRUCTURAL STEELS

Moscow STAL' in Russian No 2, Feb 77 pp 132-135

POPOVA, T. N., CHIKINA, V. G. and VILISOV, V. F., Zlatoust Metallurgical Plant

[Abstract] The extension of heat treatment modes developed earlier to increasingly large ingots with high mass produced in recent years by electric-slag remelting and vacuum-arc remelting has led to an increase in the reject rate due to hot cracks, deviations in hardness from the established norms, to an increase in the number of repeat annealing cycles and to deterioration in the workability of ingots by broaching. The Zlatoust Metallurgical Plant has studied the problem of improving the quality of ingots and increasing the yield of usable high strength structural steel of types EP56, 14Kh17N2, VL-1, etc. Replacement of cooling of the ingots in air under caps with accumulation for up to 6 days can increase the productivity of soaking furnaces and reduce the time of the entire technological cycle. Improvement of the heat treatment loads of ESR steel practically eliminates the need for repeat annealing. Positive results were achieved by annealing from the phase recrystallization point by heating to 820°C, holding 10 hr plus 0.2 hr/t, cooling at 50 C/hr to 500°C, then further cooling in air. Eighty-five annealing cycles were performed in electric furnaces using this mode, and no variations in hardness were observed; 42 annealing cycles were performed in gas furnaces and only 1 repeat annealing cycle was required. Figures 3; References: 3 Russian.

USSR

UDC 669.183.2

PRODUCTION OF LOW-CARBON NON-AGING STEEL BY MICROALLOYING WITH TITANIUM AND ALUMINUM

Moscow STAL' in Russian No 1, Jan 77 pp 28-31

SMOLYARENKO, D. A., GREKOV, Ye. A., VORONOV, Yu. F., ROVENSKAYA, T. V. and TUPITSA, V. I., Central Scientific Research Institute for Ferrous Metallurgy and Krivorog Metallurgical Plant

[Abstract] The influence of the content of titanium in rolled products and wire on hardness and impact toughness of the ferrite in welded joints was studied under laboratory conditions. The greatest microhardness and lowest impact toughness of ferrite in the seam zone were noted when the steel welded contained 0.21-0.23% titanium. When the content of titanium in the



steel was decreased to 0.13%, impact toughness of the ferrite increased to 4.5-6.7 kg·m/cm<sup>2</sup>. The combined studies showed that low-carbon non-aging steel microalloyed with titanium and aluminum has good ductility and improved technological properties for drawing of wire. The content of nonmetallic inclusions in the metal of the experimental melts was 41.7% lower than in normal melts. If the steel is deoxidized in the mold, a higher degree of desulfuration and reduction of liquation of carbon, manganese, sulfur and titanium is achieved through the height of the ingot. The consumption of titanium-containing materials is reduced by 2.4 times. Figures 3; References: 3 Russian.

USSR

UDC 621.73:669.15'24'26'28-194.001.2

#### STUDY OF THE NATURE OF HAIRLINE CRACKS IN FORGINGS OF Cr-Ni-Mo STEELS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 9, Sep 76 pp 3-4

RYBAKOVA, Yu. A., Balyura, L. S., Kleshchev, A. S. and Gorin, V. A.

[Abstract] In many cases forgings of Cr-Ni-Mo steel produced by the duplex process are found to have hairline cracks. The macrostructure of the defective parts before and after heat treatment clearly shows a banded structure in the form of short dark stripes and points; the cracks are oriented along the fibers and are caused by layer separation in nonaxial liquation cords. These sectors of layer separation result from the location of sulfides in the forging in rows. Metallographic study of the area shows rows of bluish gray nonmetallic inclusions located parallel to the edges of the cracks. Thus, the primary reason for formation of hairline cracks in these forgings and the silvery spots associated with them in the fractures is the accumulation of manganese sulfides in cords of nonaxial liquation. These forging defects can be decreased by increasing the amount of the ingot removed with the riser portion or by going over to electric slag remelting as a method of steel making. Figures 4; References: 5 Russian.

USSR

UDC 669.14.018.841

INFLUENCE OF STRUCTURAL FEATURES ON THE DUCTILITY OF TYPE 08Kh18T1  
FERRITIC STEEL

Moscow STAL' in Russian No 1, Jan 77 pp 79-81

TALOV, N. P., Central Scientific Research Institute for Ferrous Metallurgy

[Abstract] In order to determine the stability of the increased ductility of strips, achieved by production of fine, stable (equiaxial) ferrite grains, good refining of the solid ferrite solution and elimination of dispersed inclusions from the grain boundaries to high temperature heating and the physical nature of any possible embrittlement, ordinary flat tensile specimens of the strips were subjected to secondary recrystallization annealing under laboratory conditions at 900 and 960°C with holding times of 5 hours. To prevent corrosion, the specimens were preliminarily sealed in evacuated quartz ampules (with titanium chips). The structural state of this ferritic chrome steel, with increased ductility produced after double cold working (with compression of 25-33% and about 67%) with intermediate and final recrystallization annealing at 920-960°C and holding for 2 to 3 minutes for a 1 mm strip was found to be instable against high temperature heating. The ductility of the steel decreased sharply due to enrichment of the secondary ferrite grain boundaries with impurities and weakening of the interconnections between grains. Figures 4; References 9: 8 Russian, 1 Western.

USSR

UDC 669.15.018.44:548.7

STUDY OF THE INFLUENCE OF TITANIUM, ZIRCONIUM AND TUNGSTEN ON PROCESSES OF  
AGING OF AUSTENITIC HEAT RESISTANT STEEL

Tula VOPR. METALLOVED. I FIZ. MET. in Russian No 4, 1975 pp 141-144

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31558  
by V. Olenicheva]

DENISOVA, I. K., KARPOVA, N. M., KOPYLOVA, V. A.

[Text] A study is made of the influence of Ti (0-0.32%), Zr (0-0.78%) and W (0-3.16%) on the processes of aging of type El481 steel (C 0.40-0.41%, Si 0.53-1.02%, Mn 8.98-9.14%, P 0.024-0.025%, S 0.010-0.011%, Cr 13.15-13.25%, Ni 8.50-8.65%, Mo 0-1.33%, V 1.59-1.67%). Specimens hardened from 1150 and 1200°C were aged at 700°C for 4, 8, 12, 20 and 32 hrs. The change in the width of the (222)  $\alpha$  line of austenite and hardness in the process of aging and the change in specific thermal effect as a function of heating temperature for hardening are studied.

USSR

UDC 669.14:669.112.227.32

ORIENTATION RELATIONSHIP BETWEEN PEARLITE AND AUSTENITE IN HYPEREUTECTOID STEELS

Moscow TEZISY DOKL. X VSES. KONF. PO ELEKTRON, MIKROSKOPII, Tashkent in Russian T. 1, 1976 pp 178-179

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31182 by R. Ivanova]

SCHASTLIVTSEV, V. M., YAKOVLEVA, I. L.

[Text] The electron-microscope method was used to study the orientation relationships (OR) between the initial austenite grain and products of pearlitic conversion at 550°C (with separation of hypereutectoid, widmanstatten and carbide components) in 120G4 and 110G8 steels. Good agreement is observed between experimental and calculated OR between ferrite and austenite if the ferrite is seeded with observation of the Bagaryatskiy OR. The existing OR, as well as the oriented seeding of austenite observed upon subsequent heating are explained by the phenomenon of structural heredity in steel with the pearlitic structure. 2 figures.

USSR

UDC 621.789-977

THE POSSIBILITY OF USING HIGH-SPEED DEFORMATION FOR THERMOMECHANICAL HARDENING OF STEELS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 9, Sep 76 pp 5-7

SMIRNOV, M. A., GANAGO, O. A., VAYSMAN, I. M., KENDYSH, V. P. and DAMMER, A. E.

[Abstract] A study was made to determine the possibility of using high-speed stamping for high-temperature thermomechanical working. The studies were performed on austenitic steels, including one dispersion hardened variety (El69). Stamping was performed at 20 m/s and compared with upsetting at 0.02, 0.2 and 4 m/s. The degree of deformation in all cases was 30%. It was found that high speed stamping can be used to harden austenitic steels, essentially increasing the strength characteristics while conserving a comparatively high level of ductility. However, it should be considered that the substructure formed with this method of treatment has certain specifics which may affect the behavior of the hardened metal under various loading conditions. Further studies are needed to answer this question. Figures 4; References: 3 Russian.

USSR

UDC 669.187.26

# THE QUALITY OF ELECTRIC-SLAG-REMELTED HIGH-SPEED STEEL

Moscow STAL' in Russian No 3, Mar 77 pp 219-223

MOSHKEVICH, L. D., TISHAYEV, S. I., SOYNIKOV, I. F., MININZON, R. D. and MOSHKEVICH, Ye. I., Ukrainian Scientific Research Institute for Specialized Steels and "Dneprospetsstal'" Plant

[Abstract] A study was made of the structure and properties of the R6M5 and R6M5K5 high-speed steels in a square or circle measuring 80-210 mm, produced by a combined technology including ESR of large ingots 425 mm in diameter, multistage high-temperature heat treatment and press forging. This combined industrial technology for production of high-speed steels specifically includes electric slag remelting of large ingots (assuring even distribution of the carbide phase, absence of large liquation sectors in the axial zone of the ingot and defect-free macrostructure), gradual high-temperature heat treatment of the ingots (combined with heating for deformation, increasing the ductility of the metal and assuring partial breakdown and spheroidization of eutectic carbides) and forging on hydraulic presses, which assures good working of the metal. Steel manufactured by this technology manifests practically defect-free macrostructure, a reduction of carbide heterogeneity by 1 or 2 grades in comparison to metal from open arc melting with the same specimen size, high strength and homogeneity of properties through the cross section of forgings, higher strength and lower quantities of carbide accumulation in comparison to individually forged discs of the same diameter (80-210 mm) made of metal produced by the ordinary technology. Tests in cutting tools showed an increase in tool life by 20-40%. Figures 5; References: 6 Russian.

USSR

UDC 669.14.018.8-413

# FEATURES OF THE TECHNOLOGY OF PRODUCTION OF LARGE SHEETS OF O3Kh21N21M4GB LOW-CARBON CORROSION-RESISTANT STEEL

Moscow STAL' in Russian No 3, Mar 77 pp 256-259

UL'YANIN, YE. A., KOMISSAROV, A. I., BOGOLYUBSKIY, S. D., KONDRAT'YEV, A. I. and SMIRNOVA, A. V., Central Scientific Research Institute for Ferrous Metallurgy and Chelyabinsk Metallurgical Plant

[Abstract] A technology has been introduced at the Chelyabinsk Metallurgical Plant for the production of large, wide sheets 10-20 mm thick of type O3Kh21N21M4GB (Z135) steel, which has high resistance to general and intercrystalline corrosion in welded joints under production conditions in tests covering up to 6 years. This steel is needed for the manufacture of

high-power metal extractors. The metal was melted in a 40 ton arc furnace using a fresh charge. Oxygen was blown through the iron-nickel melt until the carbon content reached 0.004-0.007%. Low-carbon ferrochrome type FKKh002, a special chrome-manganese master alloy type FKKhM10-FKKhM20 and ferroniobium was used for alloying. The steel was poured into molds by the siphon method, producing primarily rectangular 6.2 ton ingots. Exothermic briquettes were placed on the bottom of the mold before pouring. The metallurgical defects of the steel in ingots, slabs and sheets are studied and classified. Recommendations are given for their prevention and correction, including strict observation of the optimal melting and pouring technology, elimination of the defective portion of the metal, maintenance of the heating temperature at the proper level, cleaning of the surface and repeated remelting. Figures 6; References: 3 Russian.

## Superhard Materials

USSR

UDC 546.26

### DIAMOND SYNTHESIS. 6. DIAMOND SYNTHESIS FROM A MIXTURE OF HYDROCARBONS (NON-ADDITIVITY OF THE REACTION RATES)

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 51, No 1, Jan 77 pp 47-50  
manuscript received 27 Nov 74

FEDOSEYEV, D. V., and USPENSKAYA, K. S., Academy of Sciences USSR,  
Institute of Physical Chemistry, Moscow

[Abstract] Investigation of the diamond growth kinetics from mixtures of methane-acetylene and acetylene-ethylene showed that the experimentally derived overall growth rate is below that calculated for the above systems. No additive effect was noted. Figures 4; References: 6 Russian.

USSR

UDC 549.211

### SOME PROPERTIES OF DIAMOND MADE BY AN EXPLOSIVE METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 4, Apr 77 pp 649-653 manuscript received 9 Oct 75

ADADUROV, G. A., BALUYEV, A. V., BREUSOV, O. N., DROBYSHEV, V. N.,  
ROGACHEVA, A. I., SAPEGIN, A. M. and TATSIY, V. F., Institute of New  
Chemical Problems, Academy of Sciences USSR, Institute of Chemical Physics,  
Academy of Sciences USSR

[Abstract] The authors study the physical and chemical properties of diamond synthesized by subjecting graphite to high temperatures and pressures produced by detonating explosives. The technique is not described in detail, and will be the subject of a separate paper. The diamond is a mixture of cubic and hexagonal modifications. Diffractometer recordings are compared for the "explosive" diamond and for grade ASM 2/1 synthetic diamond. The ratio of intensities of reflections corresponding to the cubic and hexagonal modifications shows that the admixture of the hexagonal diamond in the purified product does not exceed 5-10%. For this reason and because of the high degree of dispersity and defectiveness of the "explosive" product, some reflections of the hexagonal form cannot be observed on the diffractometer recording. It was found that the specific surface of the "explosive" diamond varies from 20 to 42 m<sup>2</sup>/g, which corresponds to an average particle size of 410-820 Å. The material is thermally stable: after heating in vacuum for 30 minutes at 800°C the diffractometer recording still showed only a mixture of cubic and hexagonal modifications. Mass spectra of the gas phase showed lines corresponding to the ions O<sup>+</sup>, H<sub>2</sub>O<sup>+</sup>, Ar<sup>+</sup>, CO<sup>+</sup> and CO<sub>2</sub><sup>+</sup>. Figures 3; References: 8 Western.

USSR

UDC 869.14:669.112.227.33

QUANTITATIVE ESTIMATE OF THE STRUCTURAL PARAMETERS OF LOWER BAINITE UPON HARDENING OF U8 STEEL BY THE METHOD OF HIGH TEMPERATURE THERMOMECHANICAL ISOTHERMAL WORKING

Novosibirsk SUBSTRUKTURA I KONSTRUKTIV. PROCHNOST' STALI in Russian 1976 pp 47-54

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31183 by the authors]

TIKHOMIROVA, L. B., TEREBILO, T. I.

[Text] An electron microscope method (thin foils and replicas) was used to study the peculiarities of the morphology of lower bainite produced from deformed austenite. General dispersion of the bainitic crystals was detected with reinforcement of their block structure and activation of carbide formation in comparison to the decay of the ordinary, undeformed austenite (isothermal hardening). The peculiarities of the structure of lower bainite after thermomechanical isothermal treatment are explained by the fact of heredity of the subgrain structure of the deformed and polygonized austenite by the bainite. 4 figures; 7 references.

USSR

UDC 519.28

INVESTIGATION OF THE THERMOMECHANICAL TREATMENT OF THE KhN77TYuR ALLOY

Ordzhonikidze IVUZ, TSIVETNAYA METALLURGIYA in Russian No 1, 1977 pp 160-162 manuscript received 11 Nov 75

BARAZ, V. R., RODIONOV, D. P. and GRACHEV, S. V., Ural Polytechnic Institute, Institute of the Physics of Metals, Academy of Sciences USSR

[Abstract] The authors investigate the regimes of thermomechanical hardening by cold plastic deformation and aging which ensure optimum properties. The concentration of basic elements in the alloy is the following: 0.06% C, 20.5% Cr, 2.6% Ti, 0.70% Al, 0.01% B and the remainder nickel. From the data accumulated here the authors were able to judge the influence of the degree of deformation and aging temperature on the properties of the alloy. They also use detailed graphs to establish the most feasible regimes of thermomechanical treatment as a function of the required level of elastic limit and resistance of stress relaxation. Figure 1; References: 4 Russian.

USSR

UDC 539.27:541.44

## ELECTRONOGRAPHIC STUDY OF THIN FILMS OF NICKEL HYBRIDS

Moscow IZVESTIA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 226-233 manuscript received 10 Feb 75

KHODYREV, YU. P., BARANOVA, R. V., SEMILETOV, S. A., Kazan', Moscow

[Abstract] Nickel hybrids were produced directly in the chamber of an ER-100 electronograph by the interaction of films of nickel  $10^{-5}$ - $10^{-6}$  cm thick with molecular and atomic hydrogen, and also by treatment of the films with high frequency and glow discharges in an atmosphere of hydrogen. When the nickel films were bombarded with protons or  $H_2^+$  ions, produced by means of a high voltage glow discharge in an atmosphere of hydrogen, the following eight phases were formed: 1) a  $\beta$  phase with FCC lattice; 2) a  $\beta^I$  phase with a cubic primitive lattice; 3) a  $\beta^{II}$  phase with FCC lattice; 4) a  $\beta^{III}$  phase with cubic primitive lattice; 5) a  $\beta^{IV}$  phase with FCC lattice; 6) a  $\gamma$  phase with hexagonal lattice; 7) a  $\gamma^I$  phase with hexagonal lattice; and 8) a  $\gamma^{II}$  phase with hexagonal lattice. The production of the various phases is determined by the processing time of the specimen and its temperature. The presence of phase transformations and simple relationships between periods indicate the genetic interrelationship of the hybrid phases. Figures 1; References 12: 5 Russian, 2 East European, 5 Western.

USSR

## FEATURES OF THE PRODUCTION OF FILM USING HIGH ENERGY PARTICLE FLUXES

Minsk ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, 1976 pp 66-71

DOSTANKO, A. P.

[Abstract] A plasma is produced in the vapors of metals (Al, Pd, Cu, Pd-V) by means of a Penning plasma accelerator cell. Mathematical models are produced for the characteristics of the ion stream. The mathematical description produced is used to determine the optimal mode of precipitation of films yielding  $\bar{E} = 3 \pm 0.3$  keV,  $I^+ \geq n \mu A/cm^2$ . The optimal technological process for production of films by means of a high energy stream of particles was tested under industrial conditions in the creation of thin film nonrectifying contacts and interconnections to semiconductor integrated circuits with shallow p-n junctions and small element areas (not over  $15 \mu m^2$ ). It is demonstrated that the process can be



easily conducted under industrial conditions, is highly productive, allows the application of homogeneous drop-free films of metals and alloys with high adhesion to Si and SiO<sub>2</sub> even on cold substrates and the formation of low-resistance, nonrectifying contacts to n- and p- Si with high element configuration quality. Figures 4; References 7: 6 Russian, 1 Western.

## Titanium

USSR

UDC 669.295

### ANALYSIS OF THE COMPLETENESS OF UTILIZATION OF TITANIUM RAW MATERIALS

Moscow TSVETNYYE METALLY in Russian No 3, Mar 77 pp 45-47

CHERKASHIN, V. I., GALITSKIY, N. V., ALEKSANDROV, V. A.

[Abstract] Ilmenite concentrates processes at titanium-magnesium enterprises contain titanium and iron as their main components, plus such valuable rare elements as zirconium, vanadium, niobium, tantalum, scandium, etc. Utilization of these elements is desirable both from the standpoint of conservation of resources and from the standpoint of avoidance of pollution. Enterprises in this branch of industry have organized the extraction of vanadium pentoxide from vanadium-containing cakes and pulps, as well as scandium oxide from spent chloride melts. The chloride wastes formed in the process of production of titanium tetrachloride can also be used as a commercial product in the electronics industry for etching of printed circuits, by cities for treatment of sewage and dehydration of sediments, by the mining industry for beneficiation of sylvinitic ores, in the petroleum industry in the production of washing fluids, and in the construction materials and gold mining industries for the treatment of drag tailings. Utilization of these and other valuable products can be improved by improving the design of gas cleaning and dust trapping hardware, methods of utilization and extraction of valuable components such as vanadium and scandium from all intermediate products in titanium and magnesium production, and development and introduction of technologies for the extraction of niobium, tantalum and other side-product metals. Figures 2; References: 5 Russian.

USSR

UDC 669.295

### A HEAT RESISTANT TITANIUM ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77 pp 222-225 manuscript received 13 Oct 75

NIKISHOV, O. A., DOLZHANSKIY, YU. M., PLOTNIKOVA, L. V., SIBILEVA, L. I.  
Moscow

[Abstract] The purpose of this work was to develop a heat resistant titanium based alloy with  $\sigma_{100}^{600} > 37-40 \text{ kg/mm}^2$ . The alloy was to be based on the system Ti-Al-Ga-Mo-Sn-Si. The method of experimental planning was used and the regularities relating to the changing level of properties as a function of alloying were produced in the form of adequate ( $P_{\alpha}=0.95$ )

statistical models. The mathematical models were used to construct three-dimensional figures with surfaces of equal levels of the following properties: ultimate strength, elongation and reduction in area at 20°C, ultimate strength at 600°C and durability at  $\sigma = 40 \text{ kg/mm}^2$  ( $t = 600^\circ\text{C}$ ). It was found that alloying with gallium and aluminum is an effective means of increasing the heat resistance of titanium alloys, although Ti-Al-Ga ternary alloys are not of practical interest, since their properties are not superior to the level of properties of heat resistant alloys already known. Alloys in the system Ti-Al-Ga-Mo-Sn-Zr are of genuine practical interest, since they allow satisfactory technological properties to be maintained while achieving high ductility with a hot strength  $\sigma_{600^\circ\text{C}}^{100 \text{ hr}} > 37-40 \text{ kg/mm}^2$ . One such alloy is Ti+6.5Al+4Ga+1Mo+2Sn+2Zr+0.3Si. Figures 2; References 9: 3 Russian, 6 Western.

USSR

UDC 669.295:539.376

#### CREEP OF TITANIUM ALLOY OT-4

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 188-192 manuscript received 25 Dec 73

PESHKOV, V. V., RODIONOV, V. N., VORONTSOV, YE. S.

[Abstract] A study is made of the creep of titanium alloy OT-4. The alloy was tested by the method of compression using specimens 15 mm in diameter and 30 mm high. The studies were performed in a creep-testing installation at 800-1050°C and  $\sigma = 0.1-0.62 \text{ kg/mm}^2$ . The specimens were directly heated by radiation from a nichrome heating coil mounted in a quartz tube. The residual pressure in the test chamber was not over  $5 \cdot 10^{-4} \text{ mm Hg}$ . The constant load was created by the pressure difference between the chamber of the installation and the surrounding atmosphere, transmitted through an elastic membrane and pusher rod to the specimen being tested. Deformations were measured by an indicator micrometer with an accuracy of 0.01 mm. Temperature accuracy was  $\pm 5^\circ\text{C}$ . The data produced indicate that the primary mechanism of creep of this titanium alloy in this phase is intergrain slip, controlled by diffusion on the grain boundaries. The creep activation energy of this alloy in the  $\beta$  phase ( $32.0 \pm 2 \text{ kcal/mol}$ ) is close to the activation energy of self-diffusion of titanium in this phase ( $31.2 \text{ kcal/mol}$ ). This indicates that the mechanism of creep of titanium alloy OT-4 in the  $\beta$  phase is slipping of dislocations, controlled by self-diffusion. However, this conclusion can hardly be considered unambiguous and final, since OT-4 is alloyed with aluminum and magnesium, resulting in the development of a number of mechanisms hindering the movement of dislocations. Figures 5; References 8: 6 Russian, 2 Western.

USSR

UDC 669.295

DETERMINATION OF THE THERMOPHYSICAL PROPERTIES OF TITANIUM SPONGE, RARE EARTH ELEMENT CARBONATES AND OXIDES

Moscow TSVEINYE METALLY in Russian No 3, Mar 77 pp 48-51

RUSSO, V. L., IVANOV, YE. N.

[Abstract] A method is presented for determining the thermophysical properties of materials in controlled environments up to temperatures of about 1100°C, and analysis is performed on the results of investigation of the properties of the lining slag and refined portion of titanium sponge and rare earth element oxides and carbonates. It is found that in the process of vacuum separation of liquid magnesium from magnesium chloride in the micropores of the sponge, magnesium chloride covers the titanium sponge in the volume of the reaction mass with a sort of jacket, isolating the titanium from the magnesium. This fact is vital to an understanding of the mechanism of the process of reduction of titanium tetrachloride by magnesium in commercial apparatus. With a low relative content of impurities in the titanium sponge, the inert gas pressure is important. Figures 1; References: 5 Russian.

USSR

UDC 620.18

RECRYSTALLIZATION DIAGRAM OF THE VTZO ALLOY WITH DIFFERENT HYDROGEN CONTENT

Ordzhonikidze IVUZ, TSVEYNAYA METALLURGIYA in Russian No 1, 1977 pp 110-114 manuscript received 8 Dec 75

KOLACHEV, B. A., MAL'KOV, A. V. and LUZHNIKOV, L. P., Moscow Aviation Technology Institute

[Abstract] The authors investigate the influence of the degree of cold deformation, annealing temperature and hydrogen content on the structure and properties of the VTZO alloy for the purpose of constructing a recrystallization diagram. The results of the experiments show that it is technically possible to produce a fine-grained structure for beta-alloys of titanium by combining recrystallization annealing with hydrogenation. These fine-grained alloys are interesting because of the unique properties which they possess. In the beta-alloys they allow the creation of a superplastic state in the metal and by cold and hot deformation such supplemental plasticity mechanism can be implemented as grain boundary gliding and diffusion creep. Figures 4; References 6: 5 Russian, 1 Western.

## INFLUENCE OF ALUMINUM ON THE PHYSICAL PROPERTIES OF TITANIUM

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 1, 1977, pp 115-120 manuscript received 31 Oct 75

NAZIMOV, O. P., IL'YIN, A. A. and ZVONOVA, L. N., Moscow Aviation Technology Institute

[Abstract] The authors investigate the influence of aluminum on the magnetic susceptibility, electrical resistance, Hall constant, thermoelectric force and Debye temperature; in addition they study the change in periods of the titanium crystal lattice. The results are examined in the framework of the material's configuration model. It is shown that the change in physical properties with aluminum content up to 7.5 wt % in the alloys is determined by the phase composition and electron structure. The predominance of the  $d^1$  configuration in the intermediate spectrum in the region of the  $\alpha$ -solution leads to an increase in the ratio of the axes of the hexagonal close-packed lattice and produces an electron type conductivity in alloys of the system Ti-Al. Figures 4; References 11: 9 Russian, 2 Western.

## Welding

USSR

UDC 621.791.753.5:669.715

### FA-1T CLEANING FLUX FOR WELDING ALUMINUM ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 77 pp 47-49

PLISKO, V. N., Candidate of Technical Sciences, MAMON, N. D., Engineer and BUSHUYEV, YU. G., Candidate of Technical Sciences

[Abstract] The authors propose a special cleaning flux for welding aluminum alloys in protective gases on the basis of using fluoride salts which do not cause corrosion of the weld joints. They made thermodynamic computations to determine fluorides which are compatible with aluminum and magnesium. The results of these computations are depicted in the figures. The authors found that fluorides of alkali earth metals and lithium fluoride can be used as the flux base, especially the ternary system  $MgF_2$ - $LiF$ - $SrF_2$ . The effectiveness of using the FA-1T flux in welding the AMg6 alloy has been demonstrated and this flux does not influence the corrosion resistance of the weld joints. Figures 5; References: 5 Russian.

USSR

UDC 621.791.042:669.295

### WELD WIRE FOR WELDING HIGH-STRENGTH TITANIUM ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 77 pp 46-47

KUROCHKO, R. S., Candidate of Technical Sciences, MANUYLOV, N. N., Engineer, BORISOVA, YE. A., Candidate of Technical Sciences and SILKINA, YE. S., Engineer

[Abstract] The authors found that the industrially produced weld materials used in the welding of very thick titanium alloys do not guarantee the necessary strength characteristics to the weld joints. This leads to an increase in mass and to an increase in time required for manufacturing welded structures. They developed a composition of the VT20-3 weld material which possesses primarily an alpha-structure. Complex doping of the alloy with alpha-stabilizers such as Al, Sn, Zr and beta-stabilizers such as Mo and V allowed them to produce an alloy which possessed elevated heat resistance at a temperature of 500-550°C. Use of this new additive guarantees a thickness up to 30 mm at operating temperatures up to 500°C to the weld joints, made with an infusible electrode on the alloys VT20, VT3-1, VT9L, etc. Use of the VT 20-3 additive instead of the VT20-2sv increases the fatigue limit of the weld joints made from VT20 alloys by 25%. These joints have a rather high impact strength, low-cycle fatigue and heat stability. Figures 4; References 6: 5 Russian, 1 Western.

USSR

UDC 621.791.01:620.192.4:669.295

# LOW-CYCLE STRENGTH OF WELD JOINTS OF VT1-0 SHEET TITANIUM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 77 pp 29-30

KUTEPOV, S. M., Candidate of Technical Sciences, RACHKOV, V. I., Candidate of Technical Sciences and SMOL'SKIY, K. V., Engineer

[Abstract] The authors found that weld joint defects reduce the low-cycle lifetime of VT1-0 titanium by 5-10 times. The lifetime of weld joints without defects is close to that of the base metal. In making welded pressure vessels of VT1-0 titanium one must control with great care the quality of the weld joints in the zones of stress concentrations. VT1-0 titanium and weld joints of this material possess a low resistance to crack growth in the area of low-cycle stress; therefore for the fracturing stress one should take the number of cycles corresponding to the appearance of the crack. Figures 3; References: 5 Russian.

USSR

UDC 621.791.75.053.001.5:669.295

# FEATURES OF SHAPING SEAMS DURING ARC WELDING OF TITANIUM WITH ELECTRO-MAGNETIC MIXING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 77 pp 24-25

SHELENKOV, G. M., Engineer, CHERNYSH, V. P., Candidate of Technical Sciences, GUREVICH, S. M., Doctor of Technical Sciences, BLASHCHUK, V. YE., Engineer and TROYANOVSKIY, V. E., Engineer

[Abstract] The authors determine the features of shaping seams during welding with electromagnetic mixing both by restructuring of the arc in the axial magnetic field and the corresponding change in its specific pressure on the bath and by the change in the preferential direction and the rate of movement of the streams of liquid metal in the bath. Use of systems of automatic stabilization of arc voltage during welding with an infusible electrode with electromagnetic mixing permits compensating the reduction in depth of the boiling determined by restructuring of the arc in a magnetic field and spread of the arc heating spot on the finished product. Deterioration in the quality of seam shaping and the appearance of the ridge along the axis of the seam and undercuts along the welding line are the result of movement at elevated speed of the flows of the melt from the forward part of the bath to the rear part along its edges and with dispersion of the liquid metal to the crystallized. Development of these negative phenomena may be prevented by reduction of the control magnetic field reversal range and limitation of its induction. Under the test conditions the control magnetic field induction allowable in quality of seam shaping was  $2 \times 10^{-2}$  T with a reversal range of 0.08-0.20 sec. Figures 4; References: 3 Russian.

USSR

UDC 546.882'2:541.7

POLYMORPHISM OF  $\text{NbS}_2$  AT HIGH PRESSURES AND TEMPERATURES

Moscow IAN SSSR, NEORGANICHESKIYE MATERIALY in Russian Vol 13, No 3, Mar 77  
pp 419-422 manuscript received 14 Jul 75

LARCHEV, V. I. and POPOVA, S. V., Institute of High Pressure Physics,  
Academy of Sciences USSR

[Abstract] The authors synthesized new polytypes  $\text{NbS}_2$  and  $\text{NbSe}_2$  at high temperatures and pressures. These compounds have a four-layer hexagonal structure type  $4\text{H(b)}\text{-TaSe}_2$  with alternating trigonal-prismatic and octahedral coordinations of the metal atoms. The spatial group is  $\text{P6}_3/\text{mmc}$ . Using the standard magnetic method the authors measured the temperature of transition to the superconducting state of the  $\text{NbS}_2$  and  $\text{NbSe}_2$  modification produced, respectively, equal to 2.9 and 3.5°K. They suggest that the coordination type has an influence on the zone structure of the striated compounds. References 19: 1 Russian, 18 Western.

USSR

INTENSIFICATION OF LASER TREATMENT WITH AN ELECTRIC DISCHARGE

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 1(73) 1977 pp 9-11

KOVALENKO, V. S. and DYATEL, V. P., Kiev

[Abstract] The authors cited certain results of investigating laser treatment of large-diameter openings by supplying supplemental energy to the zone of effect of the laser beam in the form of an electric discharge. The data presented here clarify the trends being developed for future study of the uses of electric discharge energy for intensification of laser treatment. Investigations in these directions are necessary for developing a high-production technological process to produce openings with a diameter of 0.8-3 mm. Figures 2; References 5: 4 Russian, 1 Western.



USSR

UDC 669.14.018.8:620.17

SELECTION OF THE OPTIMUM DEFORMATION TEMPERATURE OF CHROME-NICKEL STEELS  
TO OBTAIN THE HIGH-STRENGTH STATE

Moscow METALLOVEDENIYA I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3,  
1977 pp 24-28

GORDEYEV, YU. P. and SPIRIDONOV, V. B.

[Abstract] The authors investigated the influence of deformation temperature on the properties of chrome-nickel steels with different austenite stability. They constructed a generalized scheme for changing the yield stress as a function of the position of the deformation temperature with respect to the martensite points of steel. They demonstrate that the maximum level of the strength properties is reached at a deformation temperature near the martensite point  $M_c$ , and the maximum increase in strength properties is reached as a result of deformation at a temperature near the martensite point  $M_1$ . Figures 3; References 12: 9 Russian, 3 Western.

USSR

UDC 669.3'71'1:548.53

RECRYSTALLIZATION OF Cu-Al-Fe ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian  
No 3, 1977 pp 44-47

MYULLER, N. N., AGAFONOVA, A. V. and IVANOVA, S. I., Giprotsvetmetobrabotka

[Abstract] Using the x-ray method the authors determined the temperatures of onset of recrystallization of the phases  $Cu_\alpha$  and  $Fe_\alpha$  in Cu-Al-Fe alloys and temperature of onset of recrystallization of standard aluminum bronzes BrA5, BrA7, BrA9 and BrAZh9-4 after cold deformation with a step of 40%. This method for determining half the softening of the alloy was used to establish the temperature of onset of recrystallization of two alloys on a copper base containing 8% Al, 45% Fe and 10% Al, 29% Fe at 500 and 560°, respectively, after 40% deformation. Figures 3; References 7: 6 Russian, 1 Western.

USSR

UDC 669.3:669.017:627.187.1

# FEATURES OF THE STRUCTURAL STATE OF VACUUM CONDENSATES OF COPPER-BASED ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1977 pp 47-51

POPOV, V. I.

[Abstract] The author employed the method of diffractometric analysis to investigate the phase composition and determine the lattice parameter of the condensate of alloys in the copper system Cu-Mn, Cu-B, Cu-Ge, Cu-Mn-Ge, Cu-Mn-Ti, Cu-Mn-Ni in comparison with bulk samples. The author demonstrated that the phase composition of the condensate differs from that of the bulk samples. This difference is concerned with the fact that the condensate revealed no series of phases as in the bulk samples, but phases, such as oxides, nitrides,  $Mn_2$ , etc., are observed that are lacking in the bulk samples. The lattice parameter of the alpha-phase of the condensate, as a rule, is smaller than that of the corresponding alloys. The difference in structure of the films and bulk samples is explained particularly by fractionation of the alloy into components upon evaporation in vacuum, accompanied by the redistribution of doping elements by film thickness. Figure 1; References 13: 12 Russian, 1 Western.

USSR

UDC 621.785.539:661.65:669.24

# HEAT STABILITY OF A BORATED LAYER OF A NICKEL ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1977 pp 67-68

AKULINICHEV, YE. V. and AKULINICHEVA, A. N., Kaluga Branch of the Moscow Higher Technical School imeni N. E. Bauman

[Abstract] The authors cite the results of investigations conducted to determine the heat stability of a borated layer on the alloy KhN70VMTYu. They demonstrate that the thickness of the borated layer remains virtually constant after tests at 850°C for 100 hours. The authors found that the borated layer which has a rather high heat stability presents a formidable barrier for the diffusion of oxygen into the metal and for the inverse diffusion of elements from the surface of the metal to the surrounding atmosphere. Figures 2; References: 1 Russian.

USSR

UDC 669.14.018.295:539.319

# FEATURES OF STRESS RELAXATION IN HIGH-STRENGTH STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1977 pp 73-74

KRISHTAL, M. A. and POSTNIKOV, V. A., Tol'yatti Polytechnic Institute

[Abstract] The authors are concerned with stress relaxation in high-strength steel and determine the dependence of the height of the Kester maximum on relaxation time and test temperature. They conducted the investigation on a high-frequency device using the method of a resonance rod on samples cut after different relaxation times. The measurement frequency was 1.25 kHz and the temperature range was 20-300°C. Figures 2; References 6: 4 Russian, 2 Western.

USSR

UDC 678.675:539.612

# THE PROBLEM OF FORMATION OF METAL-POLYMER JOINTS USING THIN POLYMER FILMS AS INTERMEDIATE LAYERS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 20, No 12, 1976 pp 1086-1088 manuscript received 16 Apr 76

SHCHERBAKOV, S. V., STARZHINSKIY, V. Ye. and PESETSKIY, S. S., Institute of Mechanics of Metal-Polymer Systems, Academy of Sciences BSSR

[Abstract] This article presents data produced in a study of the possibility of using thin polymer interlayers in the formation of metal-polymer adhesive joints by casting under pressure. The experiments involved the use of bilateral adhesive joints with a polymer seam thickness of 2 mm. Joints between P-6 polyamide and type 45 steel were studied. The compounds were applied to the metal from a 0.1-2% ethanol solution of polyamide; the solvent was removed by drying at room temperature. The experiment showed that the strength of the joint formed with the substrate was almost three times greater than the strength of joints produced without the polymer sublayer. The increased adhesion to the metal and cohesion strength of the sublayer are manifestations of the singular properties of the polymer, the condition of which is determined by its interaction with the surface of the metal. These properties are taken on by the polymer not in the stage of film formation from solution, but rather after its melting in contact with the substrate during pressure casting, producing metal-polymer joints with the maximum possible strength. Figures 2; References: 12 Russian.

USSR

TREATMENT OF REFRACTORY METALS AND THEIR COMPOUNDS BY LASER RADIATION

ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, 1976 pp 5-10

SAMSONOV, G. V. (deceased), KOVAL'CHENKO, M. S., VERKHOTUROV, A. D. and ROSHCHINA, A. I.

[Abstract] A study is made of the erosion resistance of refractory metals, their carbides, borides and nitrides. The specimens of refractory metals were produced by hot pressing from founders of the corresponding compound of stoichiometric composition. Porosity of the specimens was not over 5-10%, grain size 5-15  $\mu$  m. The erosion resistance of refractory metals was found to increase with increasing statistical weight of atoms with stable configurations  $d^5$ , and consequently, metals of group VI are most stable. When carbides, borides and nitrides of transition metals were struck by laser radiation, the dependence of erosion on statistical weight of atoms with stable configuration  $d^5$  of the metallic component is complex due to the presence of metal-metal bonds and metal-nonmetal bonds. Thus, among the transition metals the greatest erosion resistance was that of metals of group VI, among the carbides--of compounds of metals of group V, among the nitrides--of compounds of metals of group IV, while the borides occupied an intermediate position between the carbides and the nitrides. Figures 6; References: 11 Russian.

USSR

STUDY OF FACTORS INFLUENCING THE PROCESS OF ELECTRIC SPARK ALLOYING WITH POWDER MATERIALS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, 1976 pp 23-25

PARKANSKIY, N. Ya.

[Abstract] A type  $2^3$  factor experiment was conducted based on SR-4 powder in various fractions. The influence of the factors studied on formation of coatings was investigated by analysis of the effects of individual pulses on sleeves of type 45 steel. Regression equations are produced indicating the influence of the factors studied, based on which optimal modes can be selected (within the capabilities of the hardware available) both for application of coatings and for maximum utilization of powder. Figures 2; References: 4 Russian.

USSR

UDC 546.681'191

PRODUCTION OF THIN EPITAXIAL LAYERS OF GaAs BY THE CHLORIDE METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 2, Feb 77 pp 245-249 manuscript received 29 September 75

RODIONOV, A. V. and SVESHNIKOV, Yu. N.

[Abstract] It is shown that when thin epitaxial layers of gallium arsenide are produced, one must consider the possibility of unstable operation of the source in the initial stage of precipitation. Consideration of a number of specific features of the chloride method allows the production of micron and submicron epitaxial layers with sharp concentration transitions down to about 0.05  $\mu$ m. Figures 4; References 8: 3 Russian, 5 Western.

USSR

UDC 546.48'23'24:539.238

EPITAXIAL LAYERS OF  $\text{CdSe}_x\text{Te}_{1-x}$  SOLID SOLUTIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 2, Feb 77 pp 250-253 manuscript received 22 Oct 75

SANITAROV, V. A., YEZHOVSKIY, Yu. K. and KALINKIN, I. P., Leningrad  
Technological Institute imeni Lensovet

[Abstract] Results are presented from synthesis of layers of  $\text{CdSe}_x\text{Te}_{1-x}$  on mica substrates in a quasi-closed volume by simultaneous evaporation of CdSe + Te and CdSe + CdTe. The films were synthesized in a vacuum of about  $10^{-5}$  mm Hg in a split quartz device creating a closed volume only for the time of synthesis. The method synthesized the  $\text{CdSe}_x\text{Te}_{1-x}$  solid solution by direct substitution of tellurium for selenium in the CdSe lattice in the composition range  $0.9 < x < 1$ . Simultaneous evaporation of the two chalcogenides in the quasi-closed volume produced epitaxial layers of a number of solid solutions of  $\text{CdSe}_x\text{Te}_{1-x}$  throughout the entire range of composition. It was found that the system CdSe-CdTe shows a dependence of the width of the forbidden zone on composition with a minimum value for the  $\text{CdSe}_{0.4}\text{Te}_{0.6}$  solid solution, which has a mixed structure. Figures 4; References 10: 7 Russian, 3 Western.

USSR

UDC: 546.65-31+546.719

#### CERAMETS BASED ON RHENIUM AND RARE EARTH ELEMENT OXIDES

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 2, Feb 77 pp 275-277 manuscript received 2 Dec 75

VARFOLOMEYEV, M. B., VELICHKO, A. V., ZAYTSEVA, L. L. and SHISHKOV, N. V.

[Abstract] The purpose of this work was to produce ceramets based on rare earth perhenates and yttrium and study their properties. Reduction of Y and rare earth element perhenates with hydrogen with subsequent sintering produces "molecular" ceramets based on Re and rare earth element oxides, which have more dispersed and homogeneous structures than the "molecular" ceramets of Tc-rare earth element oxide. The dispersion of the ceramets increases in the rare earth element series from La to Lu. The microhardness of the Re phase in the ceramets is  $490 \text{ kg/mm}^2$ . The summary microhardness of the ceramet is significantly higher. Figures 1; References 5: 3 Russian, 2 Western.

USSR

UDC 546.623-31+546.824-31

#### INTERACTION OF TITANIUM AND ALUMINUM OXIDES IN REDUCING ENVIRONMENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 2, Feb 77 pp 283-287 manuscript received 18 Nov 75

BATYGIN, V. N., IVANOVA, G. A., INOZEMTSEVA, A. V., MOSKALEVA, M. P. and RESHETNIKOV, A. M.

[Abstract] Available works on the interaction of oxides of aluminum and titanium indicate the formation of solid solutions. However, the question of the charge status of Ti in the corundum lattice and the quantity of oxide dissolved remains unanswered. There are practically no data available on the influence of such factors as composition of the gas medium and form of initial products on the process of interaction and properties of products formed. This work is dedicated to the solution of these problems. The reduction of titanium dioxide was studied in hydrogen media of various compositions and in a vacuum of  $10^{-4}$ - $10^{-5}$  mm Hg in the  $700$ - $1750^\circ\text{C}$  interval. The oxygen content in the hydrogen was not over 0.02 vol. %. The interaction of titanium oxides and aluminum was studied under the same temperature and gas conditions. The influence of temperature of initial and repeated heating in dry hydrogen on changes in interplanar spacing of  $\text{Al}_2\text{O}_3$  in specimens consisting of  $\text{Al}_2\text{O}_3$  + 1-3%  $\text{TiO}_2$  is studied. It is found that the solubility of  $\text{Ti}_2\text{O}_3$  in  $\text{Al}_2\text{O}_3$  is 1.06 mol.% at  $1600^\circ\text{C}$ , 1.2 mol.% at  $1700^\circ\text{C}$  and 1.45 mol. % at  $1750^\circ\text{C}$ . The solid solutions are

sensitive to the temperature and gas mode of heat treatment: under conditions facilitating oxidation of  $Ti^{3+}$  or long isothermal holding at high temperatures, partial or complete breakdown of the solid solution occurs. Figures 5; References 12: 7 Russian, 5 Western.

USSR

UDC 546(286+24):541.12.034.2;537.32

INFLUENCE OF HIGH PRESSURE ON CONCENTRATION OF HOLES AND THERMOELECTRIC PROPERTIES OF GeTe

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian Vol 13, No 2, Feb 77 pp 371-372 manuscript received 14 Jul 75

DAVIDENKO, V. M., DRABKIN, I. A., LEV, Ye. Ya., PETROV, A. V., SYSOYEVA, L. M. and FEDL'DGUN, L. I.

[Abstract] This work presents a study of the electric properties of GeTe treated under high pressure. The initial substance used was stoichiometric GeTe containing about 1.5 at. % Ge in the second phase, and a single-phase alloy with  $Ge_{0.975}Te$ . The results produced indicate unambiguously that defects responsible for the increased concentration of holes are formed in the process of phase transition, not by temperature activation. One every interesting fact observed was a significant drop in heat conductivity above the lattice (almost by a factor of 2) after high pressure treatment, which is retained right up to 400°K. References 9: 5 Russian, 4 Western.

USSR

UDC 546.27'17:677.4:519.28

STATISTICAL MODELING OF THE TECHNOLOGY OF BORON NITRIDE FIBERS

Moscow ZAVODSKAYA LABORATORIYA in Russian No 1, Jan 77 pp 70-73 manuscript received 24 Mar 76

YAKOVLEVA, E. D., ROKHVARGER, A. Ye., VLASOV, A. S.

[Abstract] Boron nitride fibers have special strength, dielectric, corrosion, and heat-insulating properties at normal and high temperatures which permits their use as a reinforcing filler in ceramic, metallic and plastic bases for the manufacture of important articles for the electric, nuclear, aviation, and space industries. However, due to the newness of the problem and the complexity of the process, an economic technology for the production of thin boron nitride fibers has not yet been developed.

The most promising approach appears to be the process of nitriding the fibers of boron anhydride with ammonia. Nitriding of  $B_2O_3$  was done in ammonia under various conditions. The main indicator characterizing the technological process and the quality of the finished product is the nitrogen content in the boron nitride fibers. The results of laboratory and semi-industrial experiments are compared. The ambiguity and inconsistency of selection and interpretation of statistical models in the optimization of the complex technological process and construction of the control algorithm under industrial conditions are shown. The effect of nine factors on the process of nitriding boron anhydride fibers was investigated. Recommendations are given for obtaining maximum yield of boron nitride fibers under various conditions of industrial processing. Figures 2; References 8: 6 Russian, 2 Western.

USSR

UDC 669.14:669.112.227.32

#### THE KINETICS OF GROWTH OF WIDMANSTATTEN CRYSTALS OF FERRITE

Moscow PRAKTIKA TEPLOVOY MIKROSKOPII in Russian, Nauka Press 1976 pp 131-133

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 3, 1977 Abstract No 31181 by the authors]

KOSENKO, A. P., LEONT'YEV, B. A., PALAMARCHUK, L. YE.

[Text] Cinematograph of the relief on the surface directly during the course of transformation at 600-700°C and metallographic analysis in the volume of specimens 2 mm thick are used to study the kinetics of growth of crystals containing 0.2% C and 2% each of Si, Mn and Ni. The influence of the alloying elements on growth rate of the crystals is explained by the influence of alloying on the critical point in the steel, the difference in free energies of phases, etc. 2 figures.



USSR

UDC 621.787.6

APPLICATION OF METHODS OF SUPERFICIAL PLASTIC DEFORMATION TO INCREASE THE FATIGUE STRENGTH OF THE DISKS OF THE COMPRESSORS OF AVIATION GAS TURBINE ENGINES

Kiev PROBLEMY PROCHNOSTI in Russian No 3 (93), Mar 77 pp 114-116 manuscript received 4 Sep 75

AGISHEV, B. M., YELANTSEV, A. A., MOISEYLENKOV, N. V.

[Abstract] This work demonstrates the possibility and desirability of using technological methods for increasing the fatigue strength of the disks of gas turbine engine compressors. The primary methods used to increase the strength of the disks consisted of surface deformation by rolling balls over the transitional sectors of the disks where fatigue cracks were observed to develop. The hardening mode used was  $P=550-700$  kg,  $i=4-6$ ,  $n=10-50$  rpm (for first stage disks), and  $P=1100-1250$  kg,  $i=1$ ,  $S=0.1-0.2$  mm/rev,  $R_h = 4.5$  mm,  $n=10-50$  rpm (for disks in the seventh and ninth stages) where  $i$  is the number of passes,  $S$  is the longitudinal feed of the support of the lathe on which the disk was mounted and  $R_h$  is the radius of the hardening ball. The method was found to be more effective than shot peening. Figures 3.

USSR

UDC 669.295+669.296:621.785.3

THE FORMATION OF ROLLING AND RECRYSTALLIZATION TEXTURES IN TITANIUM AND ZIRCONIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77 pp 139-143 manuscript received 16 Sep 75

ALSAGAROV, A. A., ADAMESKU, R. A., GEL'D, P. V.

[Abstract] Results are presented from a study of the texture of cold rolling and recrystallization in iodide titanium and zirconium deformed to 40-95%. The initial materials used were strips 2 mm thick produced by rolling of bars of iodide titanium and zirconium in a vacuum rolling mill with a residual pressure of  $3-4 \cdot 10^{-5}$  mm Hg. The texture was determined by the "reflection" x-ray method in filtered copper radiation using differential discrimination. Cold rolling texture in zirconium was formed less actively than in titanium. After a high deformation (over 80%), the rolling texture of zirconium is similar to that of titanium (intensity of texture lower in zirconium), resulting from the common nature of their deformation mechanism. The texture was found to increase in titanium and

zirconium in the stage of polygonization more significantly than in technical titanium. The recrystallization textures of titanium and zirconium are similar (the texture of zirconium is weaker) and the mechanism of their formation is satisfactorily described on the basis of the theory of oriented growth. Figures 3; References 15: 2 Russian, 13 Western.

USSR

UDC 669.24'26:620.183

#### STRUCTURE AND PROPERTIES OF DISPERSION HARDENED NICKEL-CHROMIUM ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 177-181 manuscript received 27 Feb 76

BABICH, B. N., KUSTOV, YU. A., LEVINSKAYA, M. KH.

[Abstract] A study was made of the influence of production conditions on the structure and mechanical properties of a dispersion-hardened alloy with the composition Ni+20% Cr+2.5% HfO<sub>2</sub>. It was found that processes of homogenization and recrystallization of the alloy are significantly influenced by the dispersion of the chromium powder introduced. High temperature testing confirmed the advantages of the use of finer chrome powder. Rolling after extrusion leads to the formation of a fiber-type structure, oriented in the direction of rolling. The degree of deformation upon rolling significantly influences the structure and properties of the alloy. With increasing rolling compression, the grain unevenness factor increases, reaching its maximum value after deformation with a compression of 90%. Cold rolling of thin sheets following hot rolling, both with and without annealing of the hot-rolled sheets at 1300°C, demonstrating good technological plasticity of the alloy within the range of compressions studied (5-20%). Figures 5; References 7: 5 Russian, 2 Western.

USSR

ARTIFICIAL PRODUCTION OF GROWTH TWINS OF BORON NITRIDE AND BARIUM CHLORIDE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 1, May-Jun 77  
pp 69-71 manuscript received 16 Apr 76

ALEKSEYEV, YU. A., All-Union Scientific Research Institute for Abrasives  
and Grinding, Leningrad

[Abstract] Spinel growth twins of boron nitride were produced under high temperature and pressure conditions with the addition to the initial graphite-like boron nitride of special powders. The BN twins produced were long, thin formations extended along the twinning boundaries, frequently polysynthetic, with a large number of lamellae. Gaseous additives were introduced to the charge to produce individually growing twins, yielding transparent tetrahedral thin plate twins, highly extended along the twinning boundaries [110] and [112]. It was concluded that phase transformations of matter during the formation and growth of stable phase crystals leads to twinning of the crystals. Figures 3; References: 6 Russian.

USSR

UDC 546.284

CHEMICAL AND PHASE COMPOSITION OF FUSED MULLITE MADE BY AN RF HEATING  
TECHNIQUE

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
Vol 13, No 4, Apr 77 pp 712-716 manuscript received 10 Dec 74

SURKOVA, I. A., RUPPEL'T, R., BALKEVICH, V. L., POLUBOYARINOV, D. N.  
(deceased), GARANIN, V. K., OSIKO, V. V., ALEKSANDROV, V. I. and TATARINTSEV,  
V. M., Moscow Institute of Chemical Technology imeni D. I. Mendeleyev,  
Moscow State University imeni M. V. Lomonosov, Institute of Physics imeni  
Lebedev, Academy of Sciences USSR

[Abstract] The authors analyze a block of mullite made by rf heating of a charge of quartz sand and alumina. The block had a zonal structure in the longitudinal axial cross section. The macrostructure was made up of differently oriented acicular crystals. These crystals were considerably longer in the center than in the peripheral zone. The zonal structure is attributed to differences in cooling rate. The chemical-phase composition and micro-structure of the different zones were studied by microscope, and by chemical and x-ray analysis. It was found that fused mullite made by rf heating has only a single crystalline phase--mullite--and a vitreous phase of variable composition. With additional annealing the vitreous phase decreases with release of secondary mullite. Figures 4; References 10:  
6 Russian, 4 Western.

USSR

UDC 669.24'26:621.78

THE MECHANISM OF LOW TEMPERATURE TRANSFORMATION IN NICHROMES

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 2, Mar-Apr 77  
pp 163-168 manuscript received 25 Apr 75

SILAYEV, A. F., GADALOV, V. N., NAGIN, A. S., CHEVELA, O. B.,  
NOVICHKOV, P. V.

[Abstract] A theoretical analysis is presented of the behavior of the resistivity resulting from scattering of electrons on near- and far-order fluctuations and the concentration near the phase transition. Using the scattering potential with parameters defined from the theory of similarity, it is theoretically shown that the scattering of electrons on fluctuations of order and concentration near the phase transition does not lead to the presence of a peak on the curve of the temperature dependence of resistivity of nichrome. Based on theoretical and experimental studies, it is established that the K effect results from a change in the density of electron states at the Fermi level in the process of atomic ordering. Figures 3; References 11: 8 Russian, 3 Western.

USSR

UDC 539.2:541.6

ESTIMATING FORCES OF SURFACE TENSION OF FIBER

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 77 pp 12-14 manuscript  
received 21 Jun 76

LEYTANE, M. YA., Institute of Mechanics of Polymers, Academy of Sciences  
Latvian SSR, Riga

[Russian abstract provided by the source]

[Text] The author uses atomic models (17 and 24 particles) that characterize the cross section of a fiber. The equilibrium positions of the models and the forces of interaction between the internal and surface particles are calculated in accordance with the theory of central forces. The surface layer of the fiber models is characterized by a tension force that is lower in absolute value than the internal interatomic compressive forces. The energy of interaction is taken as a Mie potential. Figure 1; References 9: 6 Russian, 3 Western.

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CSO: 1842